

---

This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google<sup>TM</sup> books

<https://books.google.com>



HD9710  
.U5285  
1923

UC-NRLF



B 5 427 426

U.S. LIBRARY - U.C. BERKELEY







*(Nat'l Geog. Mag.)*



# THE NATIONAL GEOGRAPHIC MAGAZINE



COPYRIGHT, 1923, BY NATIONAL GEOGRAPHIC SOCIETY, WASHINGTON, D. C., IN THE UNITED STATES AND GREAT BRITAIN

UNIVERSITY OF CALIFORNIA  
INSTITUTE OF TRANSPORTATION  
AND TRAFFIC ENGINEERING

## THE AUTOMOBILE INDUSTRY

An American Art That Has Revolutionized Methods  
in Manufacturing and Transformed  
Transportation

BY WILLIAM JOSEPH S. WALTER

AUTHOR OF "THE PANAMA CANAL," "HOW THE WORLD IS FED," "INDUSTRY'S GREATEST ASSET—STEEL,"  
"COAL—ALLY OF AMERICAN INDUSTRY," "AMERICA'S AMAZING RAILWAY TRAFFIC,"  
ETC., IN THE NATIONAL GEOGRAPHIC MAGAZINE

*The following article presents a careful survey of the economic consequences of the development of the motor vehicle and a layman's impressions of the highly technical automobile manufacturing industry. The latter were gained during months of observation and inspection in the largest automobile factories in America, under the guidance of automotive engineers and manufacturing superintendents.—*  
THE EDITOR.

**W**ITH thirteen million motor cars and trucks now running on the roads of the United States, and with the annual demand for new ones in excess of three millions, America is both literally and figuratively "stepping on the gas" in the making of transportation history.

A quarter of a century has brought a development in the automobile industry that has outrun the dreamers, confounded the prophets, and amazed the world.

In 1898 there was one car in operation for every eighteen thousand people, each of them a hybrid creation secured by crossing a bicycle with a buggy, and installing in the product a noisy, sputtering little engine that startled the people in the streets and sent the horses on the highways into panic (see pages 348 and 349).

To-day there is one motor vehicle to every eight people, and the worst of them is a marvel of silence and service as com-

pared with the best of its early predecessors.

Thirteen million motor cars! Who can visualize them! Five for every freight and passenger car on all the railroads of the United States! Enough to carry half the people of America in a single caravan.

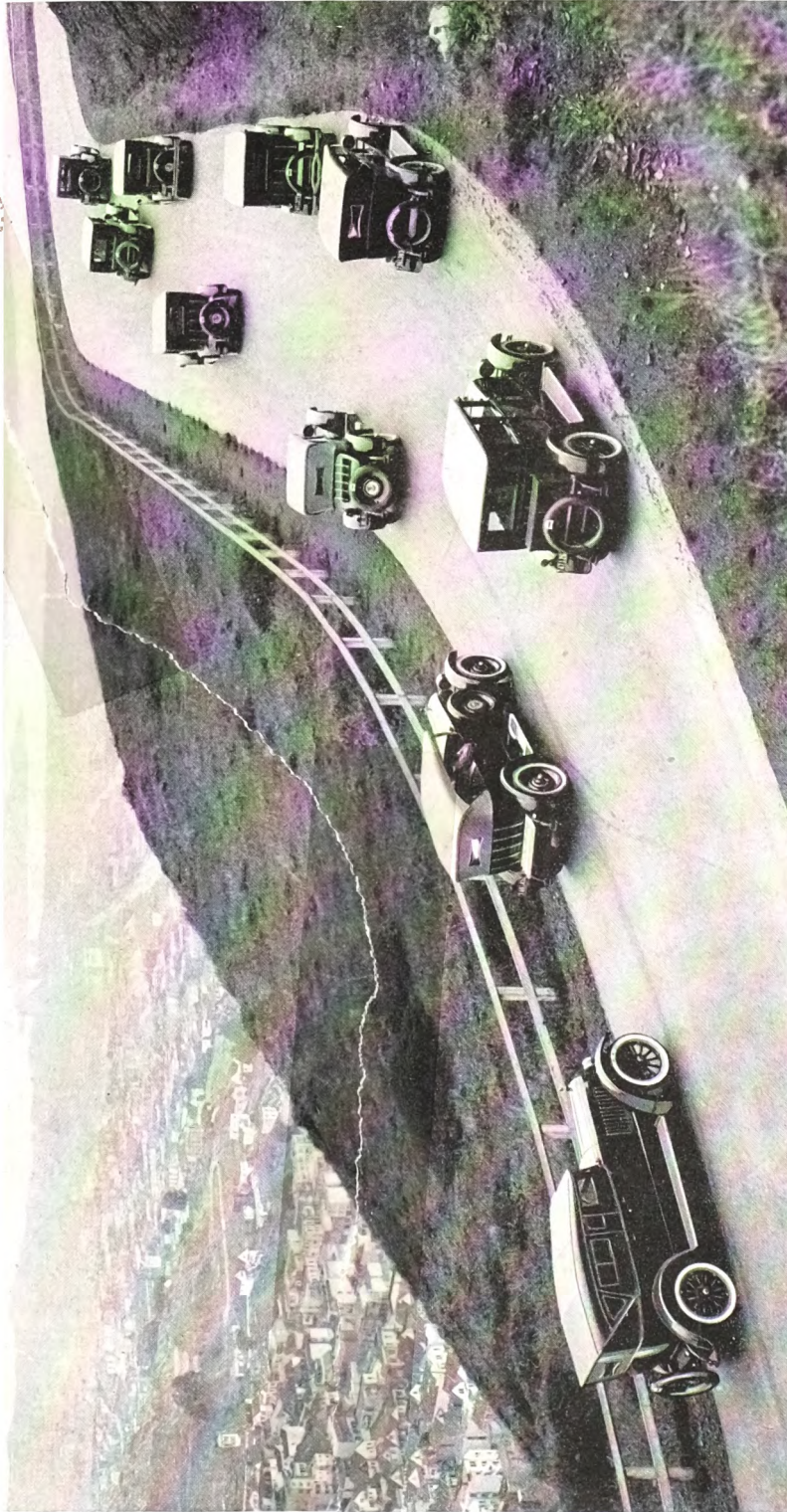
The Lincoln Highway, from the banks of the Hudson to the Golden Gate, is 3,305 miles long. To put them all on that highway, even in traffic-jam formation, would require that it be widened so that fifteen cars could stand abreast!

### ROUND TRIP TO THE SUN EVERY 21 HOURS

The service they render is proportionately large. Assuming that the average car is operated only ten months in a year and runs only twenty miles a day, their aggregate travel amounts to seventy-eight billion miles annually.

Such a mileage figure being so vast, we might conclude that ten months a year





TEN OF A KIND TAKING THE TWIN PEAKS' GRADE ON HIGH AT SAN FRANCISCO

A San Francisco distributor decided to show the world what his cars could do on heart-breaking hills. Ten owners, one a woman, came to the scratch at the foot of the hill and not a gear was shifted after the start. The power of the American-built motor represents an outstanding engineering achievement.





Photograph from N. L. Drew

#### DRIFTING DOWN THE MOUNTAIN SIDE ON THE PIKES PEAK HIGHWAY

In no other way is the relegation of the horse from the streets and highways of the country more strikingly attested than in the decadence of the horse-drawn-vehicle industry. In 1914 the output of horse-drawn vehicles was valued at \$131,000,000. In 1921 it had declined to \$42,000,000—a slump of 67.8 per cent in seven years.





© Major Hamilton Maxwell

A SECTION OF THE STORM KING HIGHWAY BETWEEN CORNWALL AND WEST POINT,  
NEW YORK

It is such scenery as this that has drawn millions of motorists and their families into the great American out-of-doors and brought rejuvenation to tired nerves and sluggish bodies.





A PICTURESQUE PIECE OF ROAD-BUILDING ON SIGNAL MOUNTAIN, TENNESSEE

and twenty miles a day overestimated the average car's performance, but both gas and tire data tend to justify an even greater mileage.

It is estimated that the gas consumption by the motor cars of the country will exceed six billion gallons this year. It is generally held that, taking every type of car, the average driver is able to coax fifteen miles out of each gallon of gas he puts into his tank. But even on the basis of thirteen miles per gallon, a little arithmetic gives the enormous total mentioned above.

It is also believed that the average tire, fabrics and cords, delivers more than 8,000 miles of service. On the basis of the number of tires put on automotive wheels annually, the aggregate motor-car mileage would be eighty billions.

Three times as many motor-miles on the highways as car-miles on the railways is a marvelous record for so youthful a competitor of rail transportation.

Counts at the New York City ferries and elsewhere indicate that the average car carries  $2\frac{1}{2}$  passengers. This means that more than thirty million people take to automotive wheels every day, or more than nine billion annually—eight times as many as are carried by all the railroads.

The transformation in the lives of the people which these figures indicate stands almost, if not quite, unparalleled in any quarter of a century of human existence.

Starting out as a plaything, transformed into a luxury, and then becoming, in turn, a definite element in our standard of living, the motor vehicle has assumed the rôle of a highly efficient factor in our

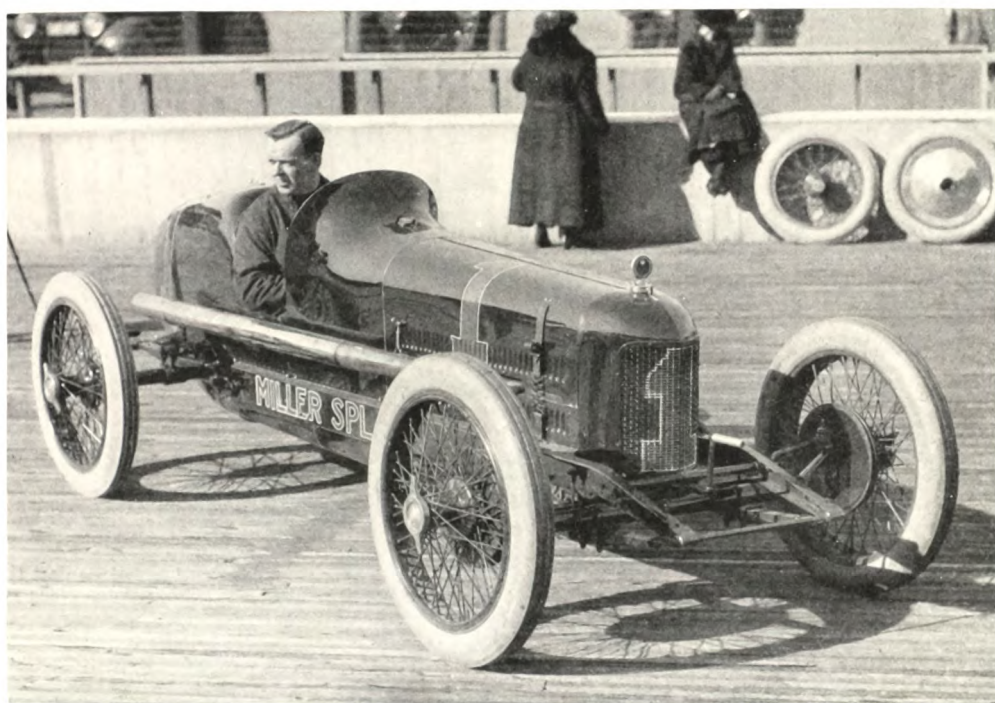




MOTERING THROUGH THE FAMOUS WAWONA TUNNEL TREE, MARIPOSA GROVE,  
CALIFORNIA

When Carl G. Fisher suggested the Lincoln Highway and Henry B. Joy sponsored it, they started a development that has done a vast service in opening up the national parks to the American motoring public and to the general cause of good roads. Roy D. Chapin followed their lead and established a scholarship in highway engineering at the University of Michigan—an idea that other universities have adopted.





Photograph by Pacific and Atlantic Service

A POWER MACHINE OF THE FIRST MAGNITUDE: A PRESENT-DAY TYPE OF RACING CAR  
READY FOR THE BIG RUN

Many of the racing cars are one-man vehicles, with a cockpit into which the driver can crouch in the event of a mishap. In some cars a sector is eliminated from the steering wheel rim to enable the driver to get his body completely into the cockpit, in the event the car rolls over.

transportation system, touching the lives and promoting the welfare of America as few developments in the history of any nation have done.

TRANSPORTATION THE LADDER OF  
CIVILIZATION

Transportation, some one has well said, has been the ladder upon which humanity climbed from a condition of primitive life to that of a finely wrought and complex civilization.

As the number of automobiles has grown, the wealth of the country has increased. In 1909 we had less than three hundred thousand motor vehicles in commission and the national income amounted to less than twenty-nine billion dollars. To-day, with our thirteen million registered vehicles, the national income is around sixty billion dollars.

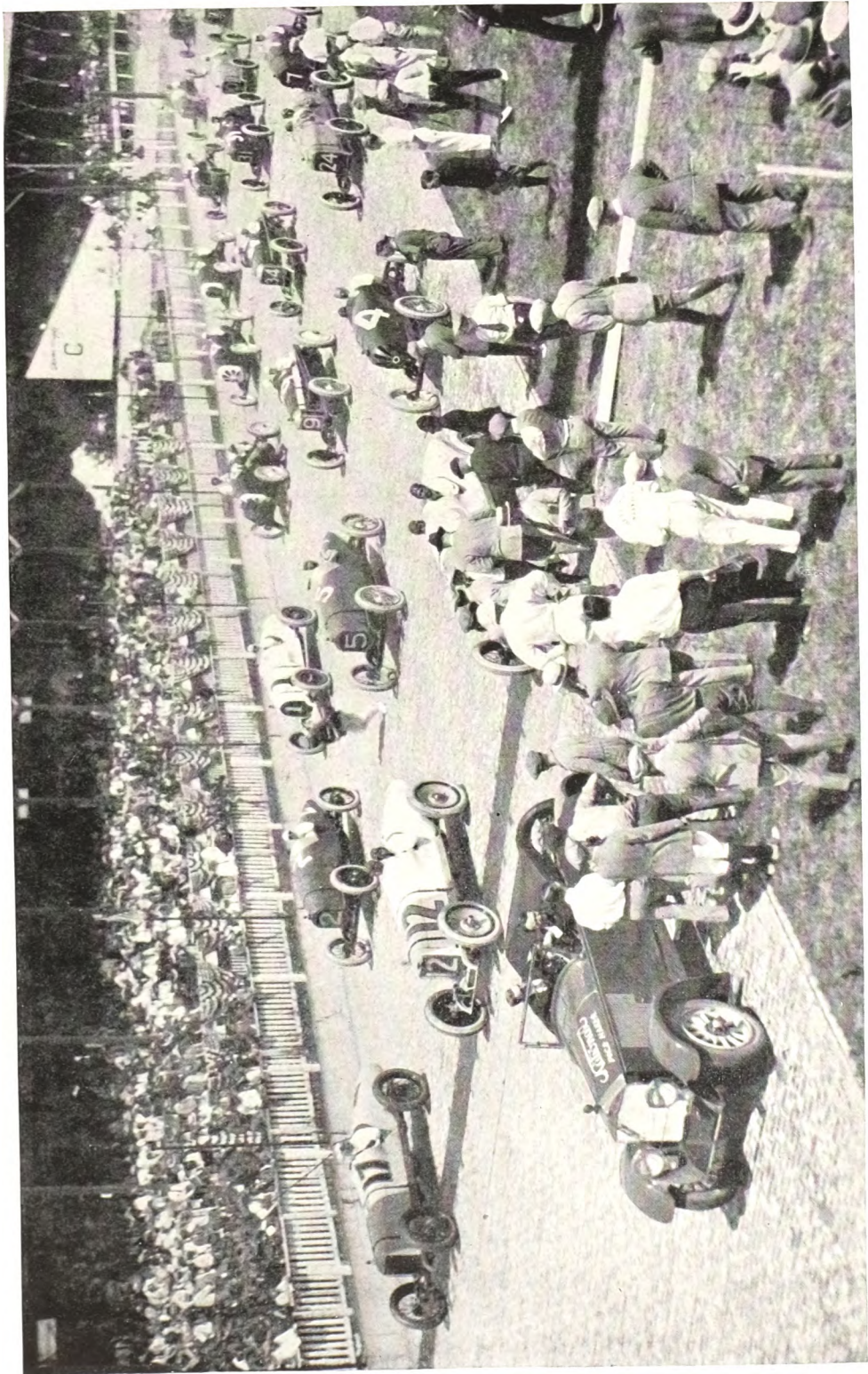
Although we are, as a nation, according to Moody, the statistician, spending

more for our automobile service than is being spent for railroad transportation, shelter, or heat and light—more, indeed, than for any other item in our national budget except clothing and meats—our savings-bank deposits and every other index of economic well-being tell the same story of the growth of our national wealth.

Economic readjustments are taking place on a major scale, and with increasing momentum, under the irresistible impact of automotive mileage.

Cities are spreading out. Long Island is built up for half its length to accommodate those who make New York the metropolis of America; so is New Jersey from Morristown to Long Branch and from Jersey City to the Empire State boundary at Suffern. Even Connecticut, as far as Stamford, Greenwich, and New Canaan, is peopled with those who work in Gotham by day and sleep in the country by night.





THE LINE-UP AT THE START OF THE SPEEDWAY 500-MILE TEST AT INDIANAPOLIS

"These terrific tests have always brought the engineering talent of the country together. Under the lessons learned there, cylinder displacement has been reduced, fuel economy has been evolved, and safety has been forged into every element of your car and mine, on the mighty anvil of a speedway and under the powerful hammer of high speed. Harmony, balance, dependability, tire mileage, and sturdiness have come from the flaming forge of a hundred miles an hour" (see text, page 384)

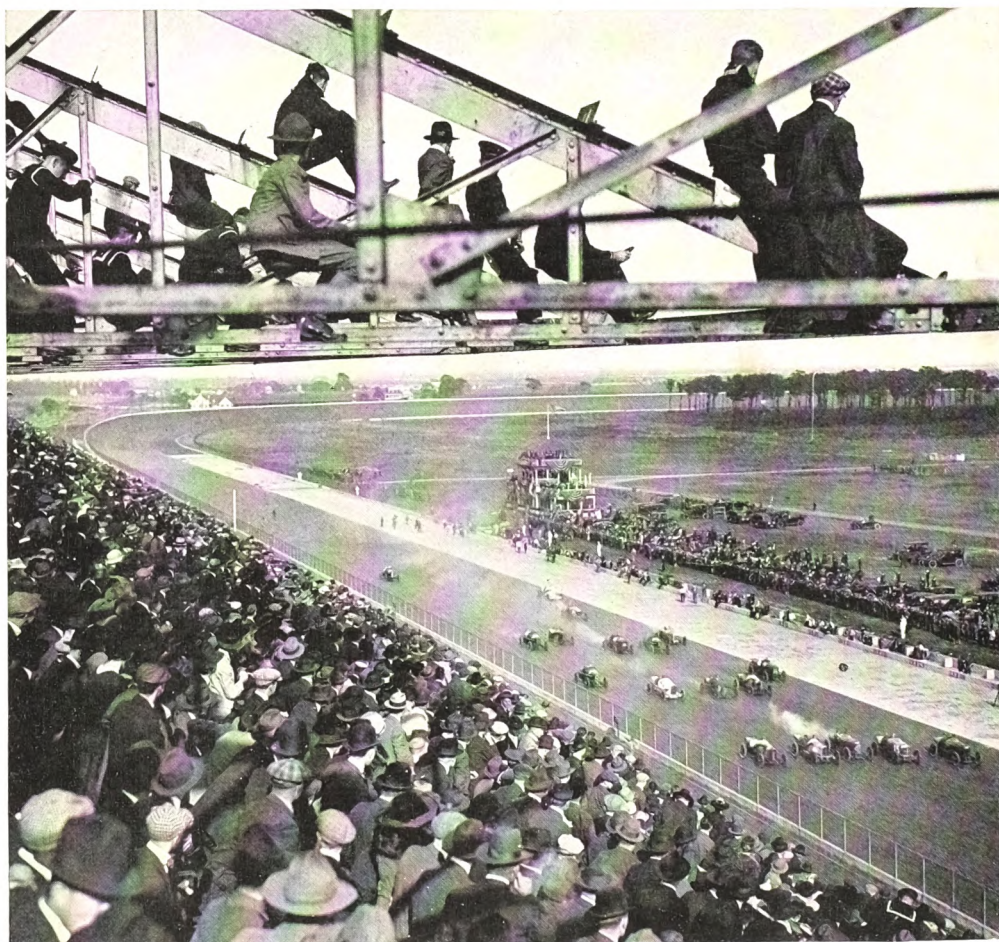




DOWN THE STRETCH WITH THROTTLES WIDE OPEN

No phase of motor-car development has brought more comfort to the car-owner than the evolution of tire dependability. In the big speedway races there is an amazing amount of skidding around the turns, and tires simply had to be improved to stand the grind. The long life that every motorist now finds in high-grade tires grew out of lessons learned in these grueling races.





Photograph by Paul Thompson

THE START OF THE HARKNESS TROPHY RACE AT THE SHEEPSHEAD BAY SPEEDWAY,  
NEW YORK

Where once the kings and queens of the turf thrilled the multitudes with the fleetness of horse flesh, now the finest creations of the automotive engineer's art flash around the course at a hundred miles an hour.

Chicago has the same story to tell, with its scores of consequential colonies, its dozens of outlying subdivisions. Philadelphia and San Francisco are but other examples of how men are coming to work in town and live in the country.

Not only in a residential way are cities undergoing a change, but also in a business way. The trek of branch banks far out beyond the business district is but one straw showing the direction of the transportation wind. The lack of parking space down town is making an ever-widening business district and new centers of commercial activity in every major urban community. The era of

down-town crowding is forcing the future to change radically our orthodox type of commercial concentration.

EVER-BROADENING RURAL HORIZONS

A similar transition is occurring on the farm. No longer are the farmer's children isolated. They can find their diversion in the pleasures of urban life after the day's rural tasks are done.

High schools are spreading out through the rural districts, and the general substitution of systematic secondary education for the little red schoolhouse type of training is of vast moment to America.

Rural horizons are being pushed back.



The twenty miles that once represented a day's journey in the farmer's little world are now less than an hour's spin.

The broadening experience that travel brings; the development of judgment and decision that automobile driving requires; the spread of mechanical knowledge that car maintenance entails; the demand for initiative and enterprise in those who would own and operate an automobile, are giving to the American people a training the value of which cannot be estimated in dollars and cents.

Many a wise leader of industry has sensed the significance of car ownership by his employees, and is encouraging them to buy homes where houses are detached and where they can own cars. The president of the Baldwin Locomotive Works has told his men that he wants all of them to have initiative enough to own cars.

ELEVEN OUT OF EVERY THIRTEEN MOTOR CARS IN THE WORLD REGISTERED HERE

What people could appreciate and capitalize the advantage of the motor car so well as those of America? Their wealth is more widely distributed than that of any other nation; their average income is equaled nowhere else on the planet; furthermore, they have an unexcelled genius for quantity production. It is these facts that are responsible for eleven out of every thirteen motor vehicles in the world being operated on American roads, and for twelve out of every thirteen produced in a given period being Yankee-made.

Surveying motor-car registration, we find that South Carolina has more cars than Australia or Argentina; that Kansas has more than France or Germany; that Michigan has more than Great Britain and Ireland.

Indeed, New York, Pennsylvania, New Jersey, and Maryland, with a combined population smaller than Poland, and with an aggregate area more limited than New Mexico, have more automobiles in service than the whole world outside of the United States.

Even the District of Columbia has more motor vehicles than Austria, Belgium, Brazil, South Africa, China, Cuba, Czechoslovakia, Denmark, India, Japan,



AT THE END OF THE TRAIL: GLACIER POINT, YOSEMITE PARK, CALIFORNIA

Through the automobile, the American people have broken the bonds that formerly tied them to narrow localities.





Photograph by Brown Brothers

A CROSS BETWEEN A BICYCLE AND A BUGGY, IN THE EARLY DAYS OF THE AUTOMOTIVE INDUSTRY

Haynes, Ford, Duryea, Winton, Olds, and Apperson are names that will live as the founders of a vast industry who build better than they knew.

Jugo-Slavia, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Rumania, Russia, Spain, Sweden, or Switzerland.

In a group of twenty-eight major cities of the country, there are more cars stolen annually, even, than are used in Austria, Belgium, Japan, or Mexico.

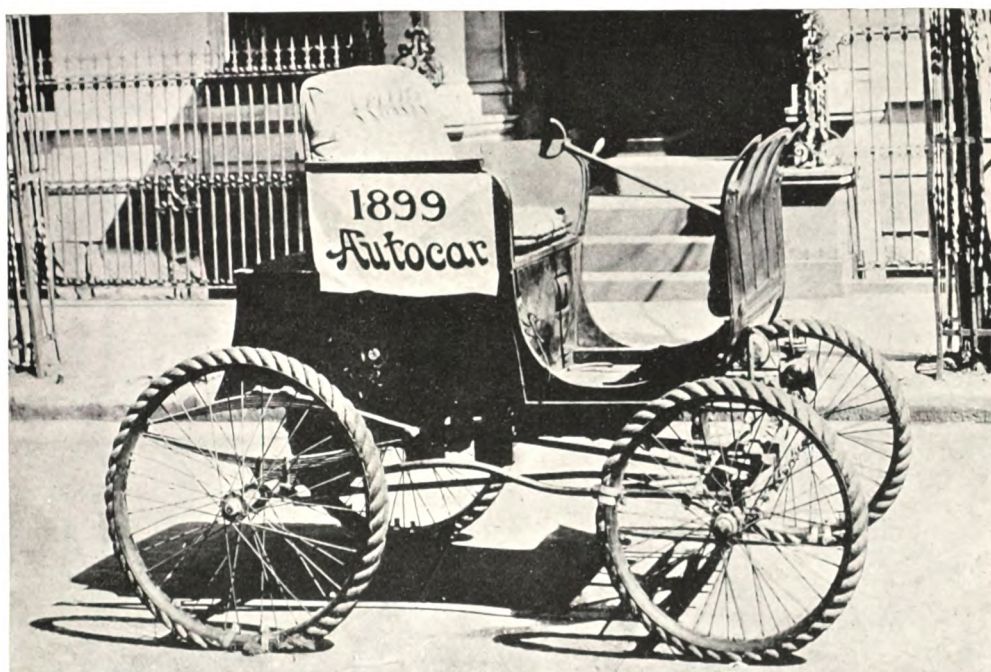
The insatiable demand for new cars, in spite of the tremendous number already in service, is disclosed by the fact that many more will be called into commission this year than were built from the birth of the industry up to the end of 1915.

Available figures indicate that the total car sales for the year will approximate five millions, including two million used vehicles. This means that one family out of every four in the country annually figures in an automobile transaction.

WHEN WILL THE POINT OF SATURATION BE REACHED?

With such facts before them, men naturally pause and wonder how it can be that the long anticipated "point of saturation"—that is, the hour when the country's demand for new cars will be limited to replacements—is not reached.





Photograph by Brown Brothers

## A ROPE-TIRED HYDROCARBON CARRIAGE OF THE 1899 TYPE

When Charles Goodyear accidentally dropped a lump of his rubber compound on a hot stove, he little dreamed of the forty million cord and fabric tires that would annually rise out of his discovery, or of the motor-car industry made possible thereby.

All the economists have been predicting its arrival for years. A decade and a half ago it was learnedly urged that the wealth of the country could never support more than two hundred thousand new cars a year. A little later it was being said that when the registration reached the five-million mark it would slow down to the slight annual increase required for the growth in population.

But that mark was passed and the expansion continued, with ten millions as the limit beyond which it seemed impossible to go. To-day that limit has been exceeded and there are once more many considerations which would seem to indicate that the "point of saturation" is close at hand. Car registration is now up to the point where it is only a million behind the telephone listings of the country, only seven millions behind the total number of families, and even closer than that to the total number of dwellings.

Yet contrary to these considerations, and in spite of the warning from financiers that many people who can't afford

them are buying cars, and in the face of the additional fact that 70 per cent of the cars being sold are bought on the deferred-payment plan, the demand goes on unchecked except as affected by seasonal conditions.

A study of Uncle Sam's expense account for motor-car transportation shows that it totals seven billion dollars annually. Men naturally wonder how we can go far beyond that, but they forget that for every dollar added to our national automobile transportation expenses we add several dollars to our national income.

## WHO CAN AFFORD AN AUTOMOBILE?

An old-time, long-headed man in the automobile industry has a theory that seems to be the answer to the issue of who can afford to buy a car.

"I get tremendously tired of all this talk about this man and that man not being able to support an automobile," said he. "It's just like the question of whether a given man can afford to get married or



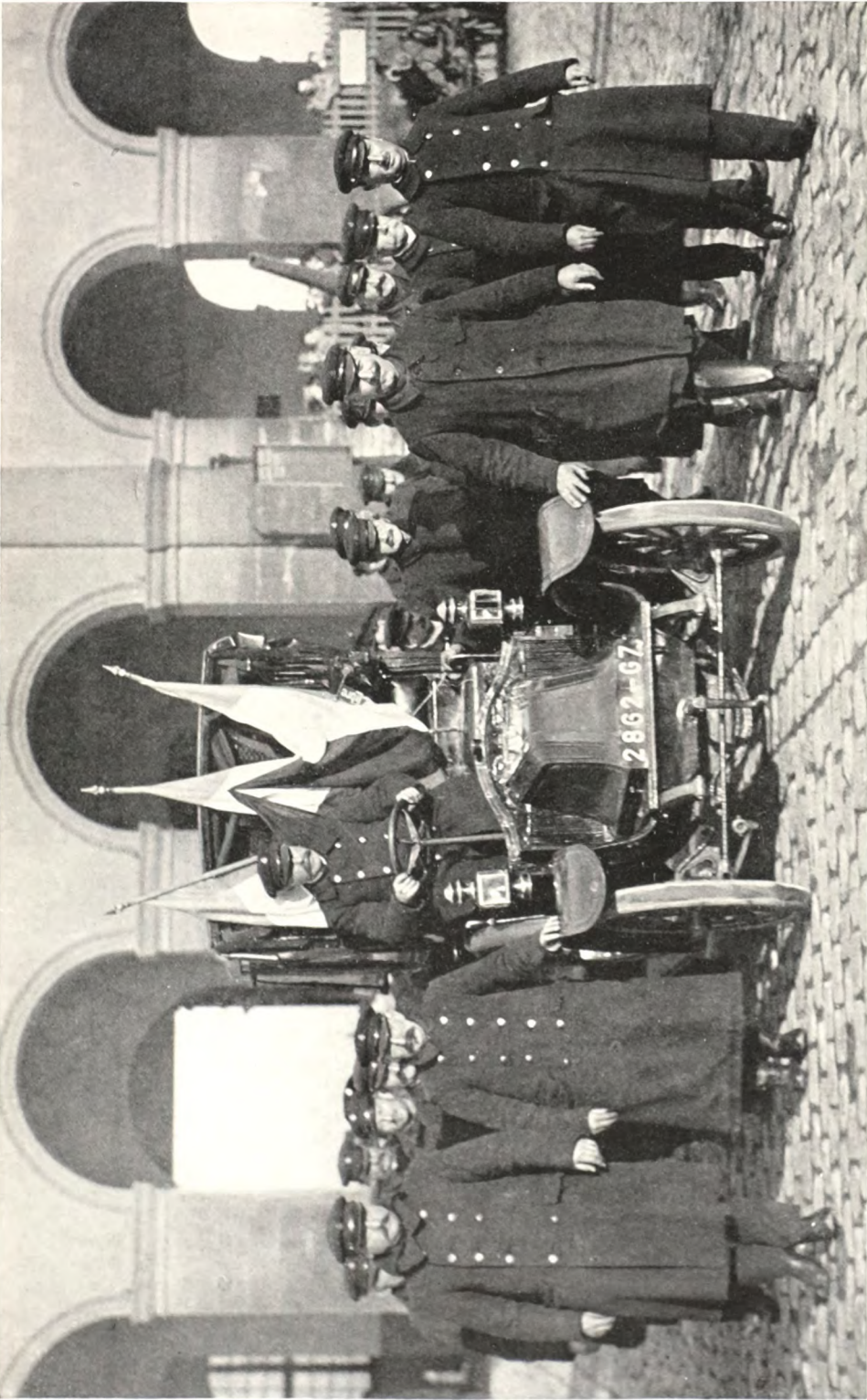


Photograph by Brown Brothers

#### EXPERIMENTAL TRANSPORTATION TWO DECADES AGO

The blacksmith and the owner of a one-hoss shay survey with disdain the new-fangled machine which presumes to travel rubber-shod over rough highways. And for many seasons, before the day of perfected motor and of service station, it was the horse or the mule which pulled the new invention out of mudholes and sand beds when engine balked and tires subsided.



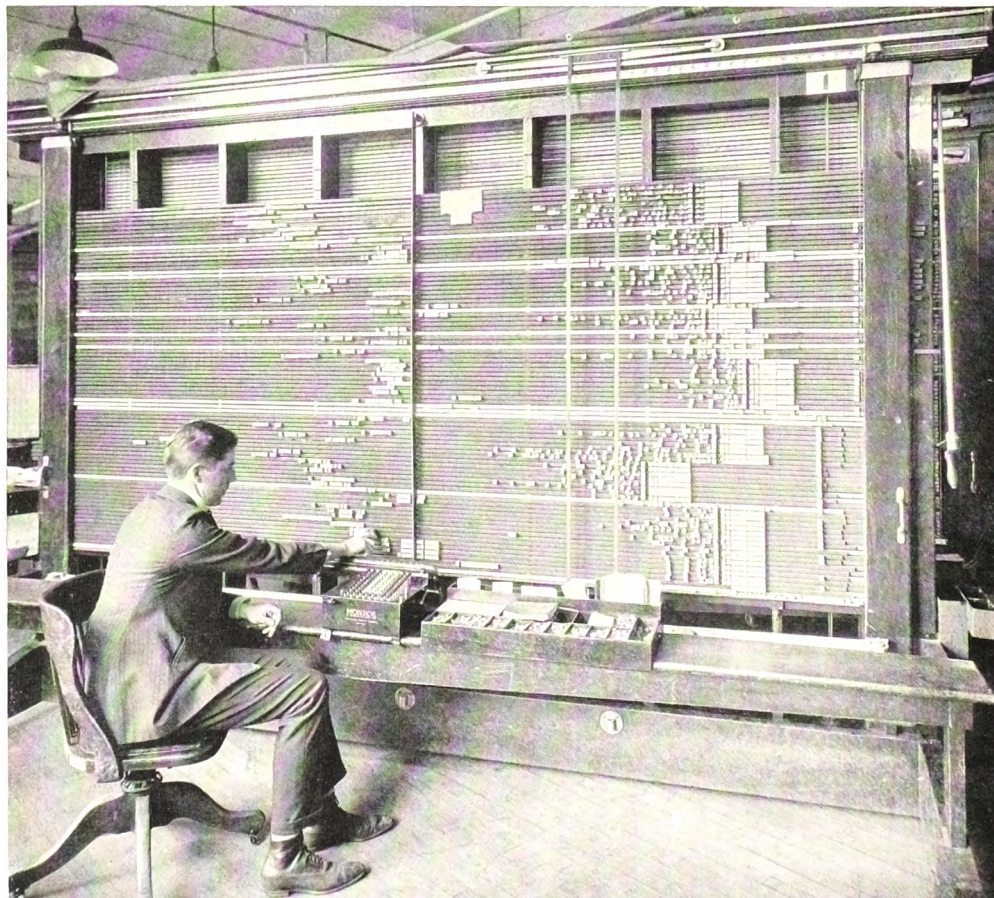


Wide World Photograph

ONE OF THE TAXIS THAT SAVED PARIS AT THE MARNE

This cab was recently driven to the courtyard of the Invalides, in Paris, where it is to take its place beside the railway coach in which Marshal Foch signed the Armistice.





THE DISPATCHER'S OFFICE IN AN AUTOMOBILE PLANT

These boards, in the production department of a major plant, control the passage through the factory of material and parts, bringing them together at the right time and showing the status of operations all the way through to the finished product.

not. One man, in whom only his bride has confidence, makes a success of matrimony and life. On the other hand, another man embarks on the matrimonial sea who is regarded as well fixed, and he makes a total failure of his venture."

Many a man is "made" by marriage, and not a few are developed by automobile ownership. But just as matrimony enriches the nation, however much it costs in dollars and cents, so does transportation—and that is what the automobile is.

Many things are happening that promise to postpone our arrival at the "point of saturation," however much the signs indicate its nearness.

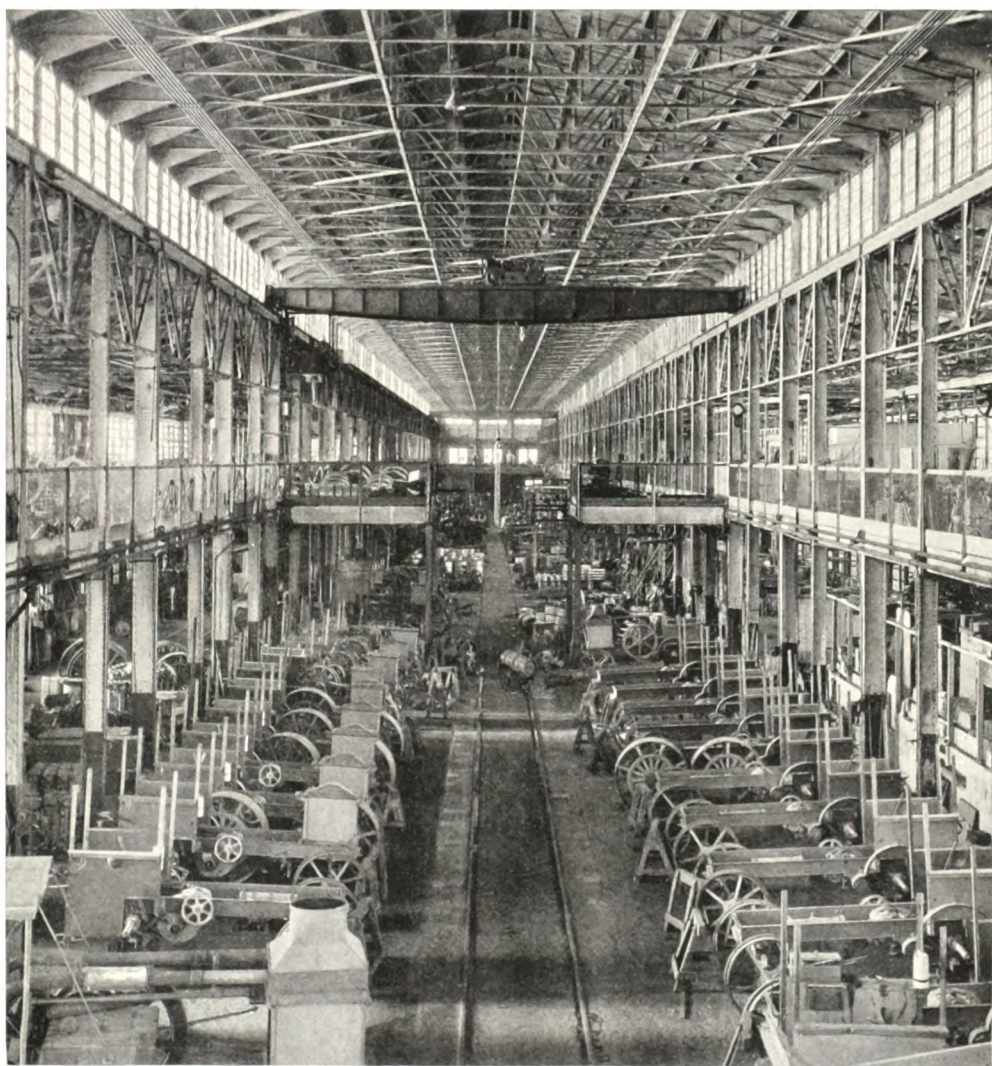
Graphs of prices and production show that price reduction has always served to

widen the demand. Every fifty dollars' reduction in selling price opens up, according to the graphs, a new field of a million prospects.

The deferred-payment plan also widened the market tremendously for all cars, and now the much-discussed "five dollars down and five a week" scheme of the Ford Motor Company is enrolling hundreds of thousands of new customers.

But that plan, it seems, is not exactly what on its face it appears to be. The dealer is to use his judgment as to how many months these payments will have to continue before the customer gets his car. If the latter convinces him of his ability to go on paying, the car will be delivered after thirty weeks. Otherwise, the whole sum, even, may be required





THE INTERIOR OF THE MACHINE SHOP OF A BIG TRACTOR PLANT

Quantity production is becoming as marked in tractor plants as in automobile factories. The Iowa State Agricultural College has found that it costs \$100 a year to keep a farm horse, and that the average horse works 723 hours. A tractor will do the work of six horses, to say nothing of the human labor saved.

before delivery is made, and by that time the buyer will have had a pretty good lesson in thrift.

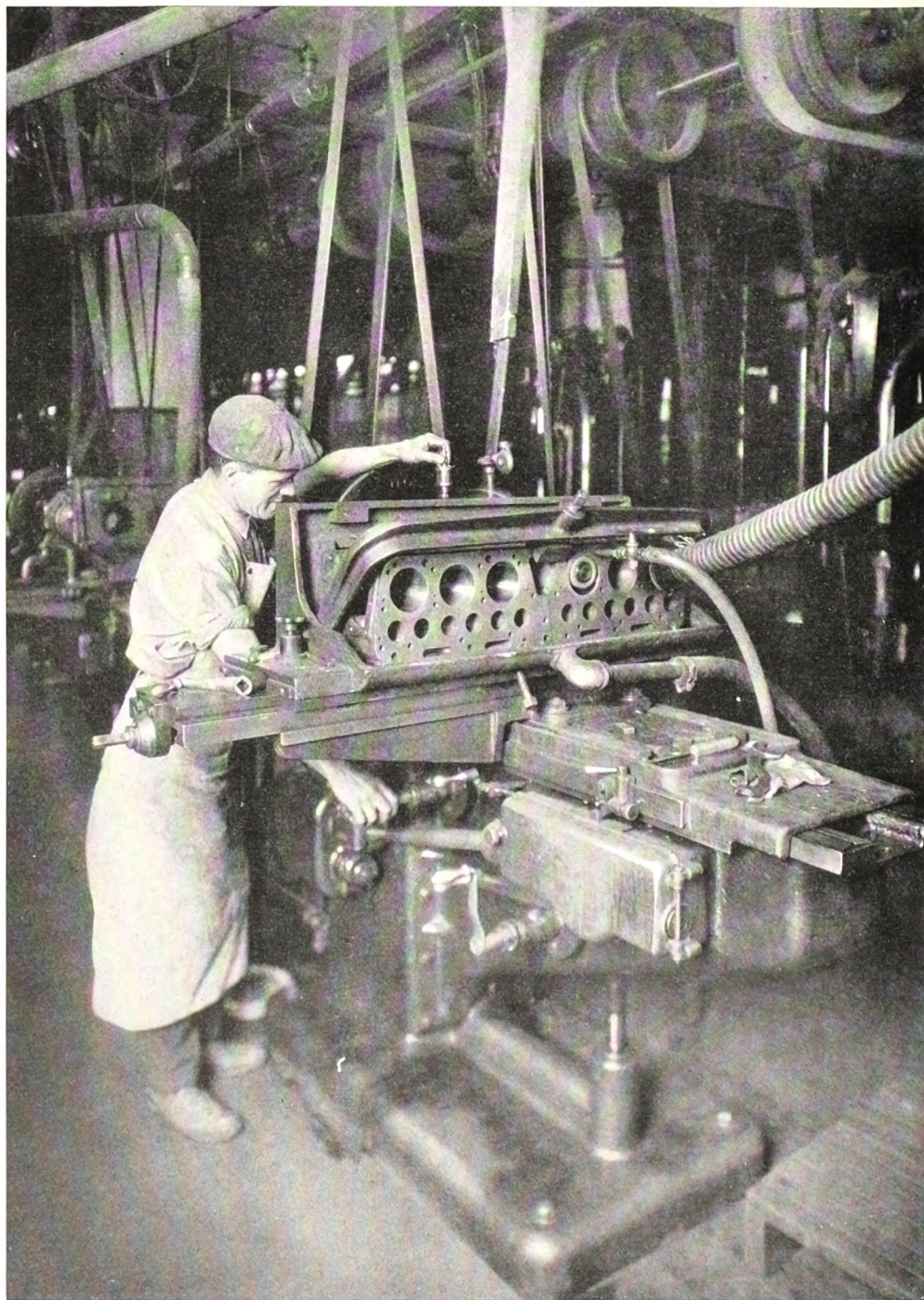
#### HUMAN EFFICIENCY AND THE AUTO-MOBILE

A questionnaire sent out to thousands of automobile owners at random all over the country throws some light on the specific increase in efficiency that the motor car brings to its possessor. The summing up of the answers shows a 56.7

per cent increase in working capacity. Applied to the millions of car-owners, this would represent the equivalent of adding nearly seven million new workers to the nation's productive forces.

The promotion of efficiency in those who own cars is only the beginning of the direct returns that the industry makes in balancing the tremendous expenditure for automobile transportation. It gives direct employment to more than a million men and indirect to two or three

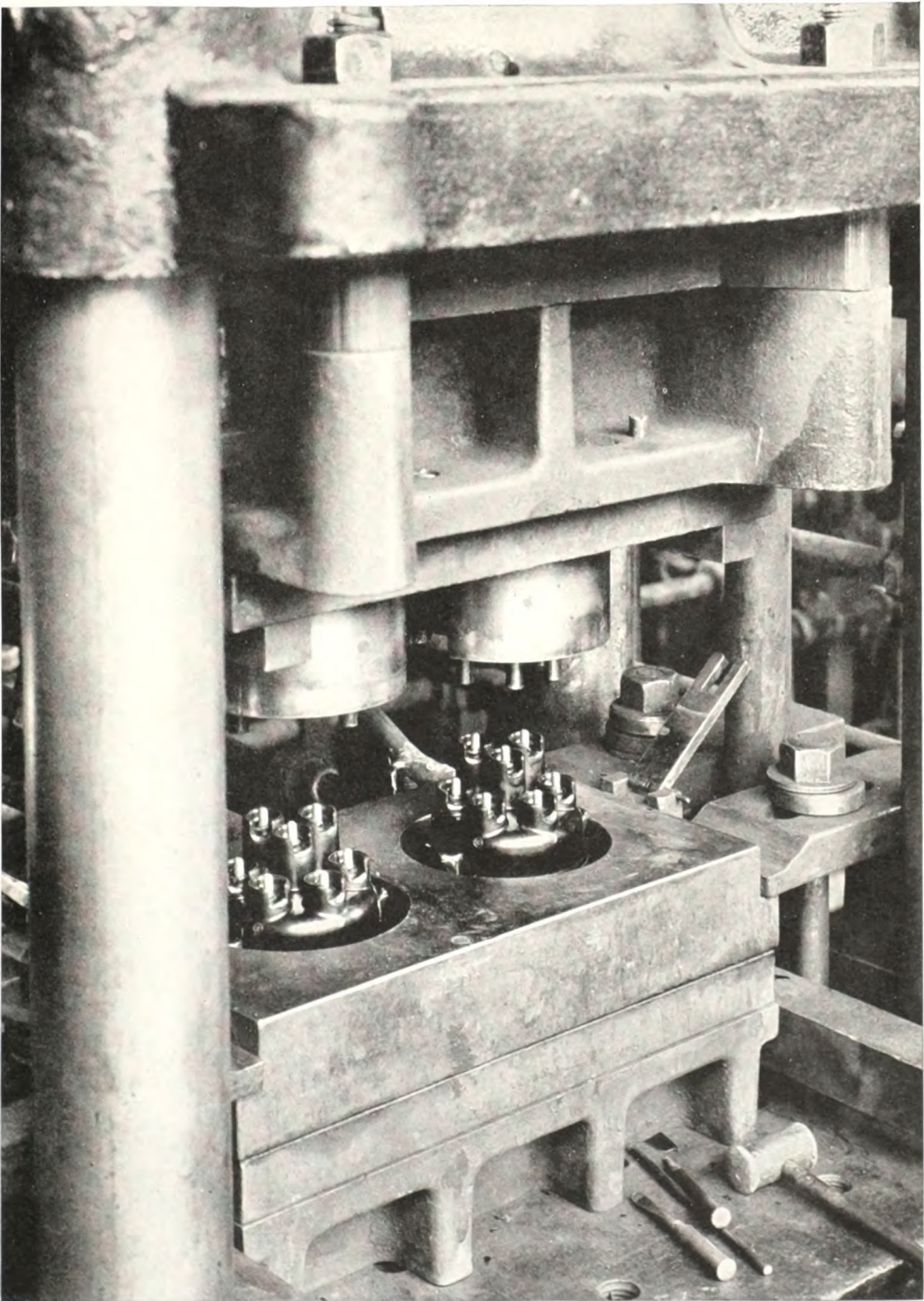




GRINDING THE CYLINDERS OF A STANDARD "SIX" ENGINE

Each cylinder in a high-grade engine must be ground exactly true, both as to size and direction. It must not depart more than one ten-thousandth of an inch from standard size. Note the emery wheel in the fourth cylinder from the left. In a six-cylinder car, each piston makes 6,000 trips through its cylinder for every mile traveled (see text, page 366).

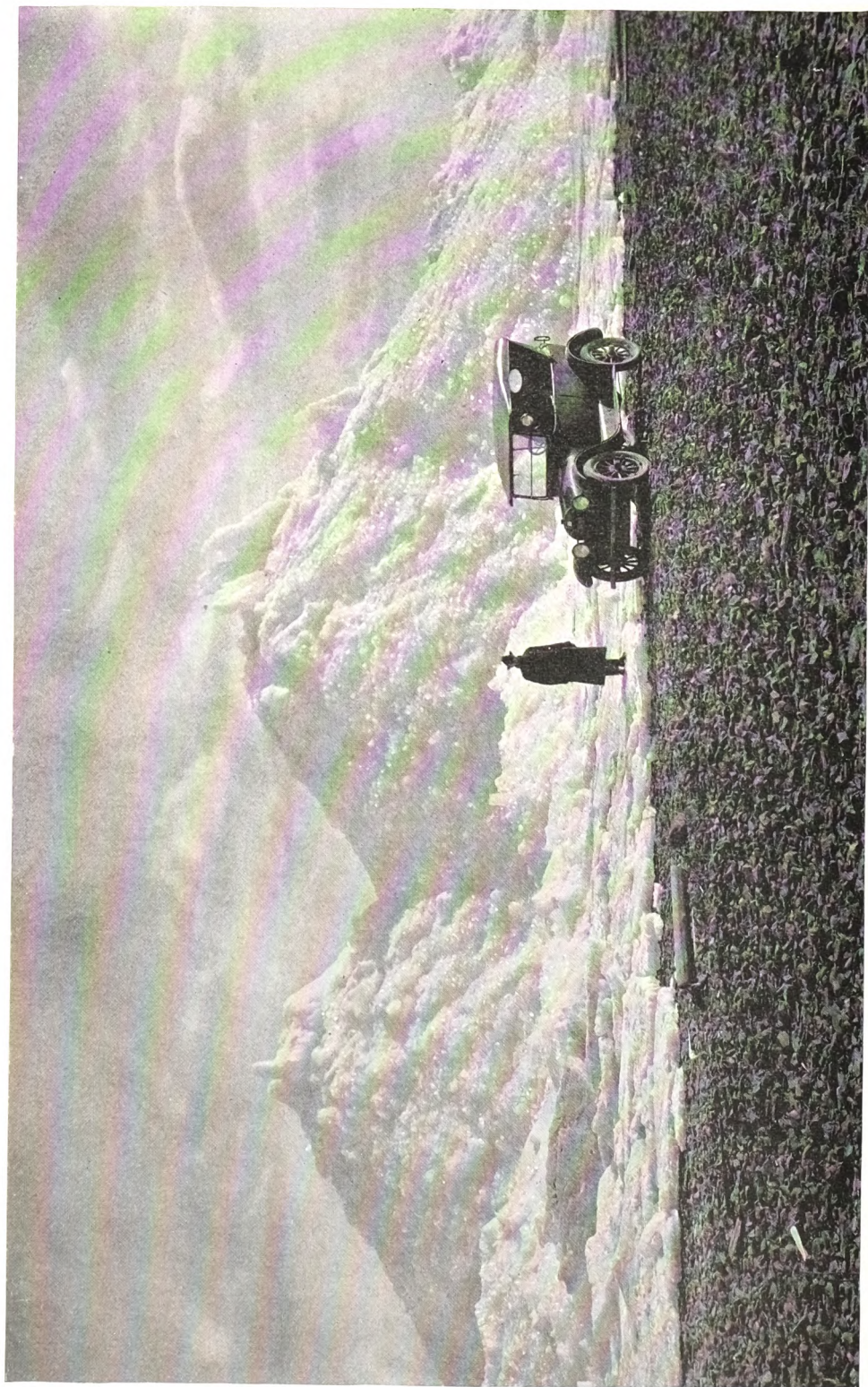




A PRESS FOR MOLDING BAKELITE DISTRIBUTER HEADS AND OTHER IGNITION PARTS

Bakelite is made by treating carbolic acid with formaldehyde, and comes to the automobile accessory manufacturer in a powdered form. He imbeds his terminals and other metal parts therein, and subjects it to high heat and heavy pressure, getting the fine, indestructible insulation required for his electrical parts, which do so much to reduce ignition difficulties.



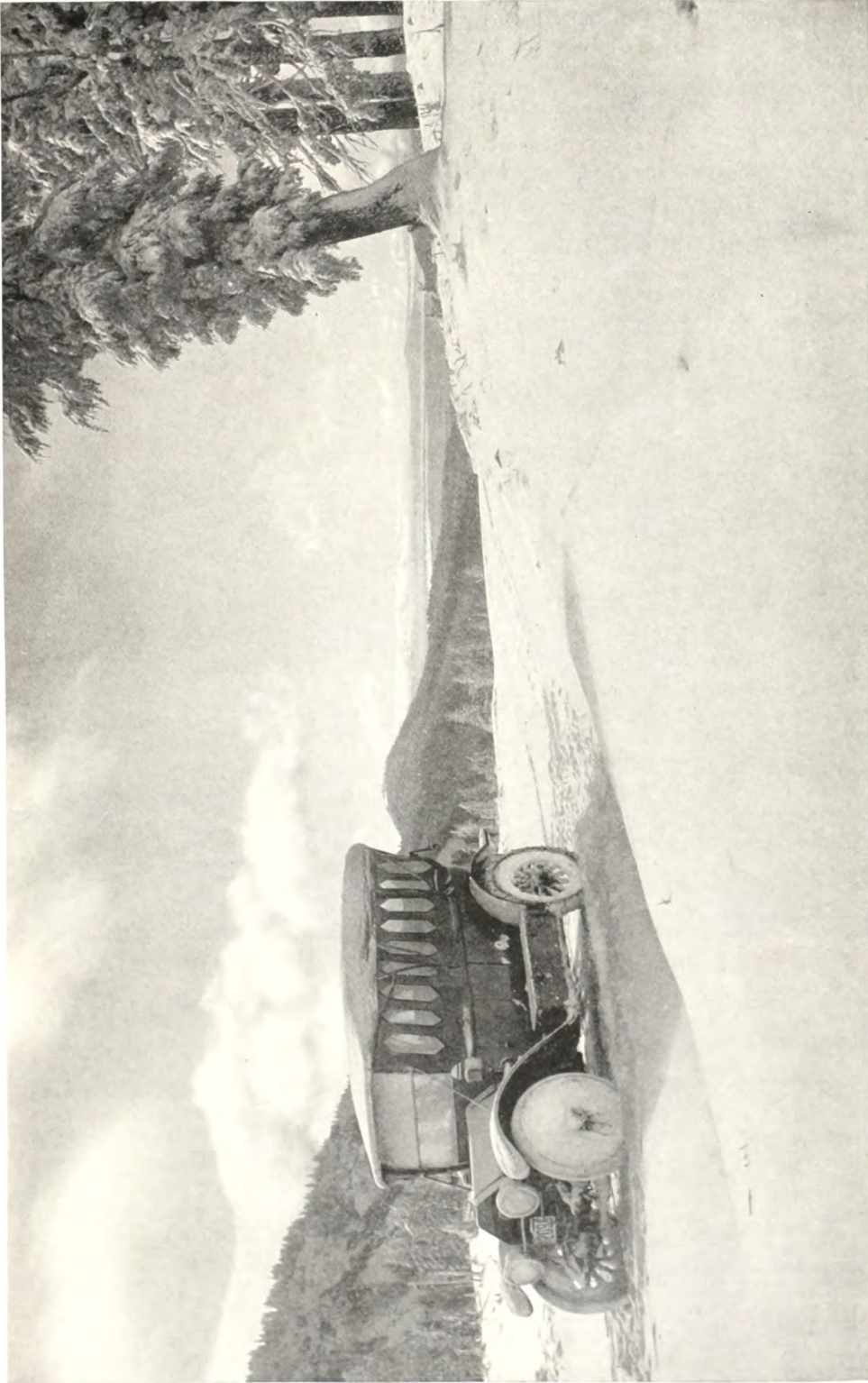


Photograph from The Robbs

BESIDE A MOUNTAIN OF ICE CAST UPON THE SHORE OF GREEN BAY, NEAR ESCANABA, MICHIGAN

Ninety per cent of the public buy their cars from 20 per cent of the manufacturers. The other 80 per cent of the manufacturers divide the remaining 10 per cent of the sales among them. But catering to the 10 per cent who want something different means a trade worth more than half a billion dollars a year.



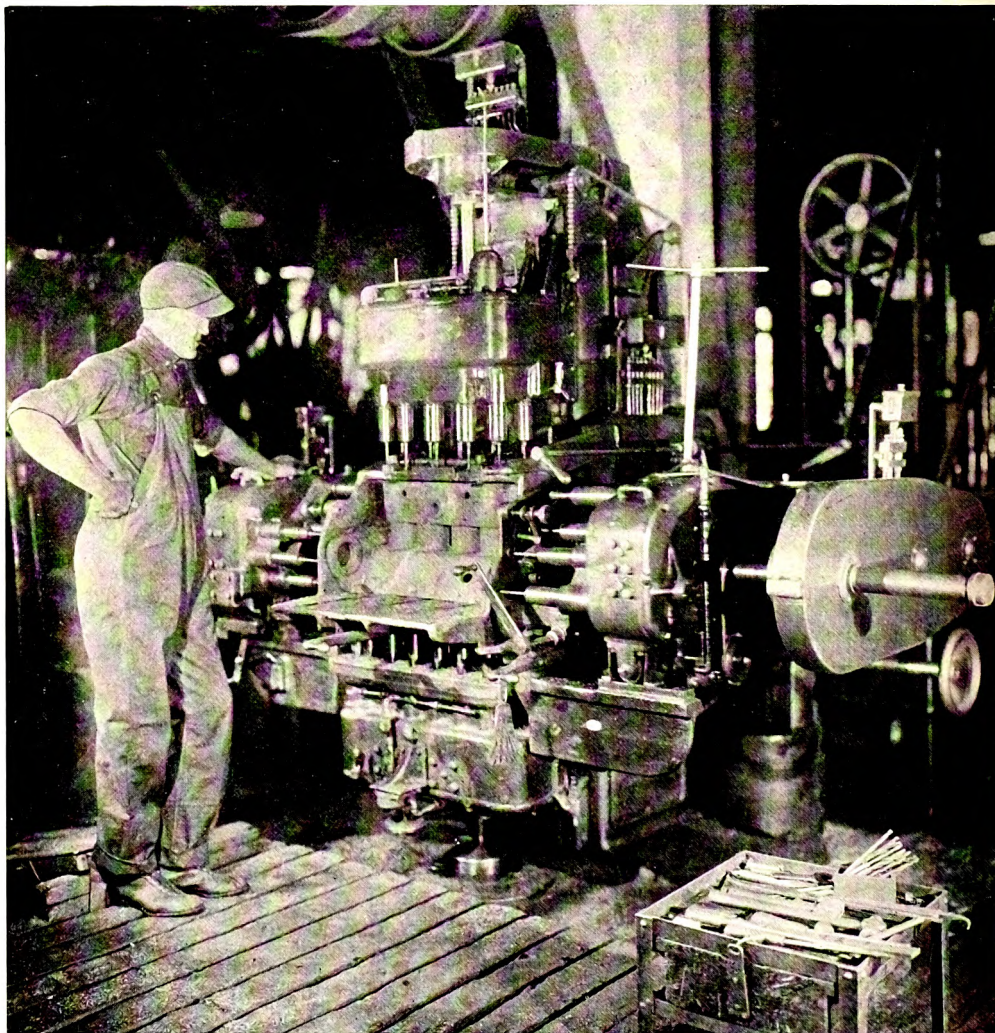


Photograph by F. H. Kiser

CAUGHT IN A SNOWSTORM ON THE RIM OF CRATER LAKE, OREGON

The cost of parts replacements in motor cars of the present day is surprisingly low, in spite of the high cost of installation. One major manufacturer shows that all parts sales for the year amounted to only \$13 per car. This is wholesale, of course.





A BIG ENGINE-BLOCK BORING MACHINE IN OPERATION

Boring some fifty holes, of various sizes and in four directions, at a single operation is typical of the methods of automobile manufacturers in reducing the cost of building cars by the elimination of unnecessary hand labor.

times as many. It buys the major portion of the country's plate glass, a vast share of its iron and steel, most of its aluminum, much of its leather. It gives the railroads much more freight to haul than it takes from them.

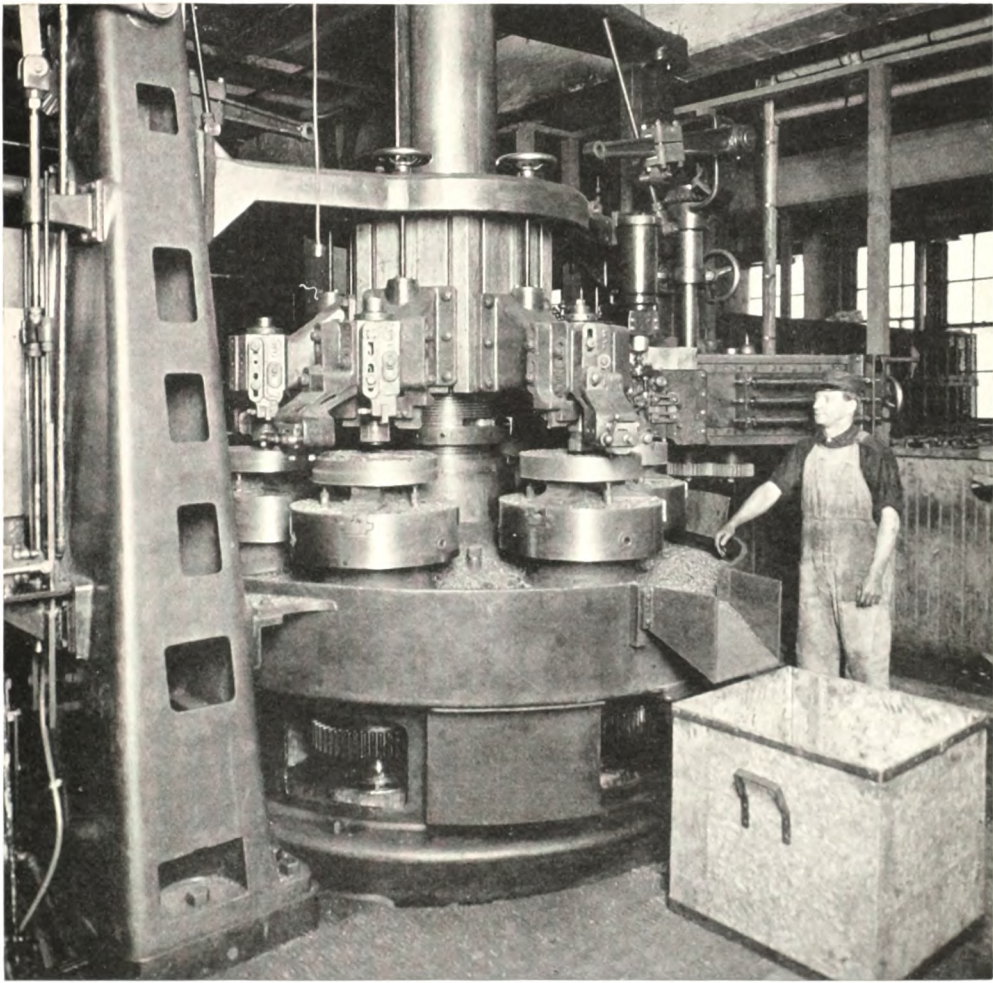
It has sent hundreds of thousands of people into the suburbs, where rents are cheaper and living conditions better, and where the savings in rent offset the car's maintenance costs, leaving the better living conditions as dividends.

Yet the direct contributions to national prosperity are small compared with the

indirect contributions briefly referred to above—the expanding city and the narrowing countryside. What stories the rusty little cars parked around the rural high school could tell of boys and girls who will finish their secondary education, when their parents never got beyond the sixth grade!

Before the coming of the motor car, the farmer who was not up at five in the morning or who had left the field before sundown in the evening was accounted a shiftless tiller of the soil. From seven to seven in the field, with his morning





MACHINING FLYWHEELS

This machine has a whole battery of cutting apparatus which dresses up half a dozen flywheels at a time.

and evening chores before and after, was his routine.

#### HOME OWNERSHIP INCREASES WITH CAR REGISTRATION

That he is now released from such a grind; that his family is coming into its normal share of diversion and recreation; that he can provide his children with opportunities that fate hitherto denied him, is due mainly to the motor car and the train of advantages it has brought him. The farm bureau, the rural woman's club, the parent-teacher association, are but a few evidences of his intellectual emancipation. In Pennsylvania 65 per

cent of the farmers own motor cars, and other States show similar percentages.

When will the point of saturation be reached, in the light of such direct and indirect returns, and in view of the fact that fewer deferred-payment buyers default on their cars than on household furniture; that definite statistics show home ownership increasing with motor-car registration; that national income increases as automotive transportation outgo swells?

Measured by California's present ratio of car-owners to population, it will not be reached until the present registration of the country is doubled.





WINDING ARMATURES FOR MOTOR-CAR GENERATORS

Until recently it has been necessary to wind armatures with these comparatively simple hand machines. To keep the tension uniform with the constant starting and stopping of the wire reels of the type shown in the left foreground was apparently an unsolvable problem. A new machine has just been perfected, however, which automatically winds the armatures, one girl being able to do the work of four, with none of the strain involved. The wire is drawn on a 15-pound tension.



Yet even California has not settled down to replacements. Measured by Indiana's existing ratio, the ultimate registration of the country would reach eighteen millions, but Indiana still shows herself far on the sunny side of saturation.

Those whose past predictions have been most nearly justified by the trend of events are making new predictions to-day, and these are that the point of saturation will not be economic, but rather physical. The congestion in the big cities is fast growing so great as to keep thousands of motorists out of the down-town districts.

#### BIG CITY TRAFFIC PROBLEMS

With all the traffic officers and signal systems, the task of handling the ever-flowing stream of motor cars and trucks grows apace. Some 42,000 motor vehicles pass the crossing at Fifth Avenue and Forty-second Street in New York every twenty-four hours; 4,500 in a single busy hour is not an unusual occurrence.

The block-signal system on Fifth Avenue, with traffic moving in a series of stops and starts, controlled from a central tower, has accomplished much, but even it is destined to prove inadequate. Boulevard traffic regulation, based on the Fifth Avenue practice, has also helped in many cities, but here again inadequacy is only a few years away.

Propositions are now coming from the foremost authorities for the establishment of express streets, where cars will move at rates of from forty to fifty miles an hour, and where gates will be established at intersections, just as at railway crossings. Commissioner Harriss, of New York, says that New York needs three north-and-south highways of this character, with traffic moving on each of them in three parallel lines in both directions. These streets, he says, will have to be four hundred feet wide and elevated in special instances.

Chicago is installing a synchronized traffic-control system similar to that now in operation in New York. This system of towers will extend south on Michigan Boulevard from Randolph Street, with the master tower at Jackson.

So great is the congestion in the famous Loop District in Chicago that proposals are being made to take all pedes-

trians off of the street level and to provide second-story sidewalks for them. The streets could then be widened to the building lines, almost doubling their present curb-to-curb width, and the sidewalks would be reached by stairways, ramps, and elevators. Vehicular and pedestrian traffic, each out of the way of the other, could move twice as fast as now and many times more safely.

It is pointed out that such a plan would give two display window stories instead of one, and that the thousands of people who now avoid the Loop District because of its congestion would come back to trade there, their reclaimed business being large enough to more than compensate the property owners for the cost of the change.

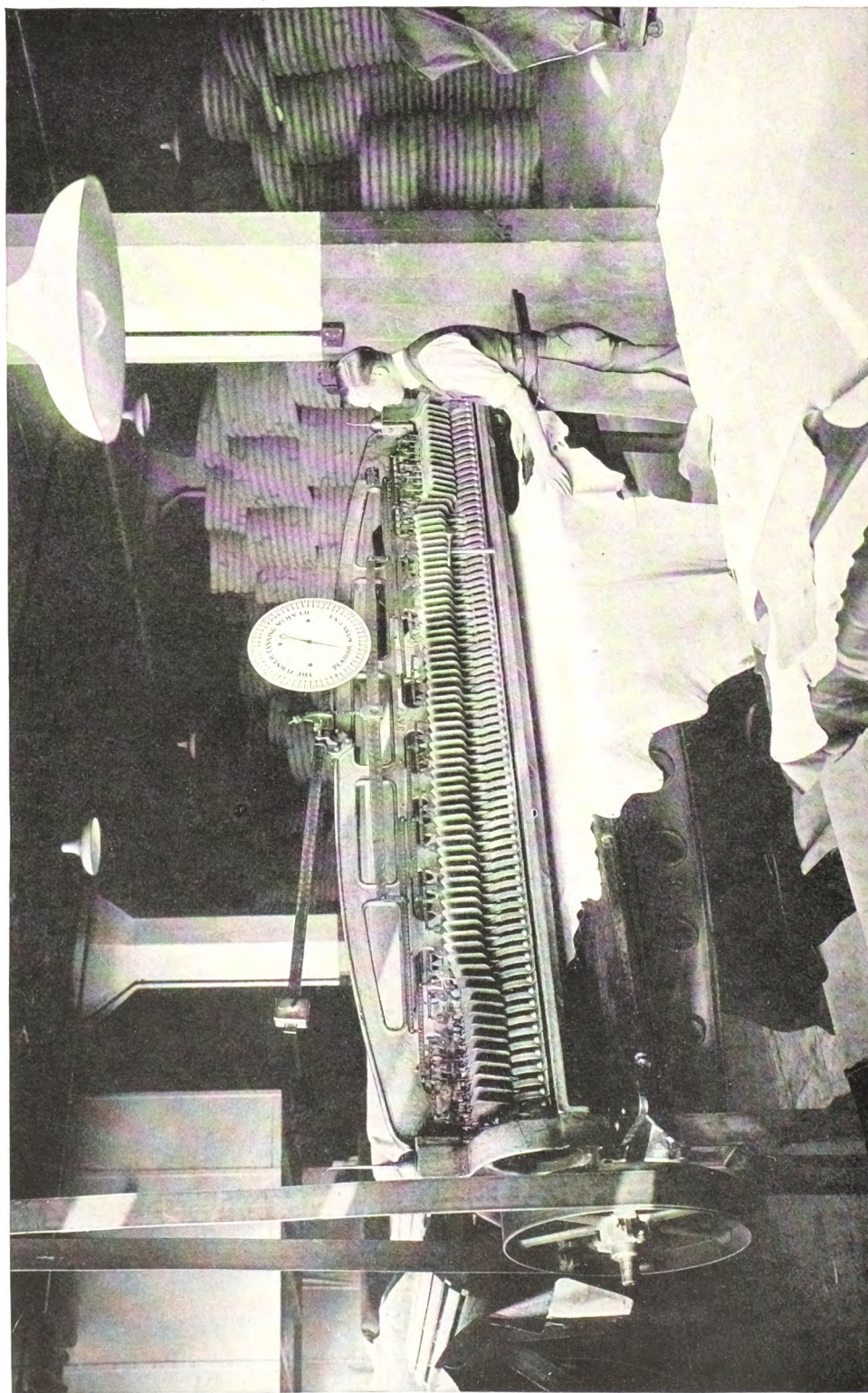
The day may not be so far in the distance when the horse-drawn vehicle will be legislated off the crowded city thoroughfares, to lessen congestion, just as heavy traffic has been banished from the boulevards to protect the motoring public. Likewise, the day will inevitably come when truck traffic will be separated from passenger-car traffic on the busier highways through the countryside, just as is now the case on the fine Roosevelt Boulevard out of Philadelphia.

But whenever the point of saturation is reached, and by whatever route, it will not come before all manufacturing facilities available to-day will be kept busy making replacements. The average life of a motor car is six years. If 18,000,000 cars shall prove the limit, replacement requirements will call for three millions a year, which represent the present annual production.

#### THE AUTOMOBILE AN EFFICIENT MECHANISM

There is little wonder that the automobile has caught the imagination of the American people. A race of individualists, the sense of power to go where they will, in their own way, has a deep appeal. Further than that, a mechanically minded people, they find a thrill in the possession of a mechanism whose purring motor bowls them along the highways at a pace that exhilarates and brings a change of scene every minute. They have a sort of subconscious reverence for its mechanical merit.

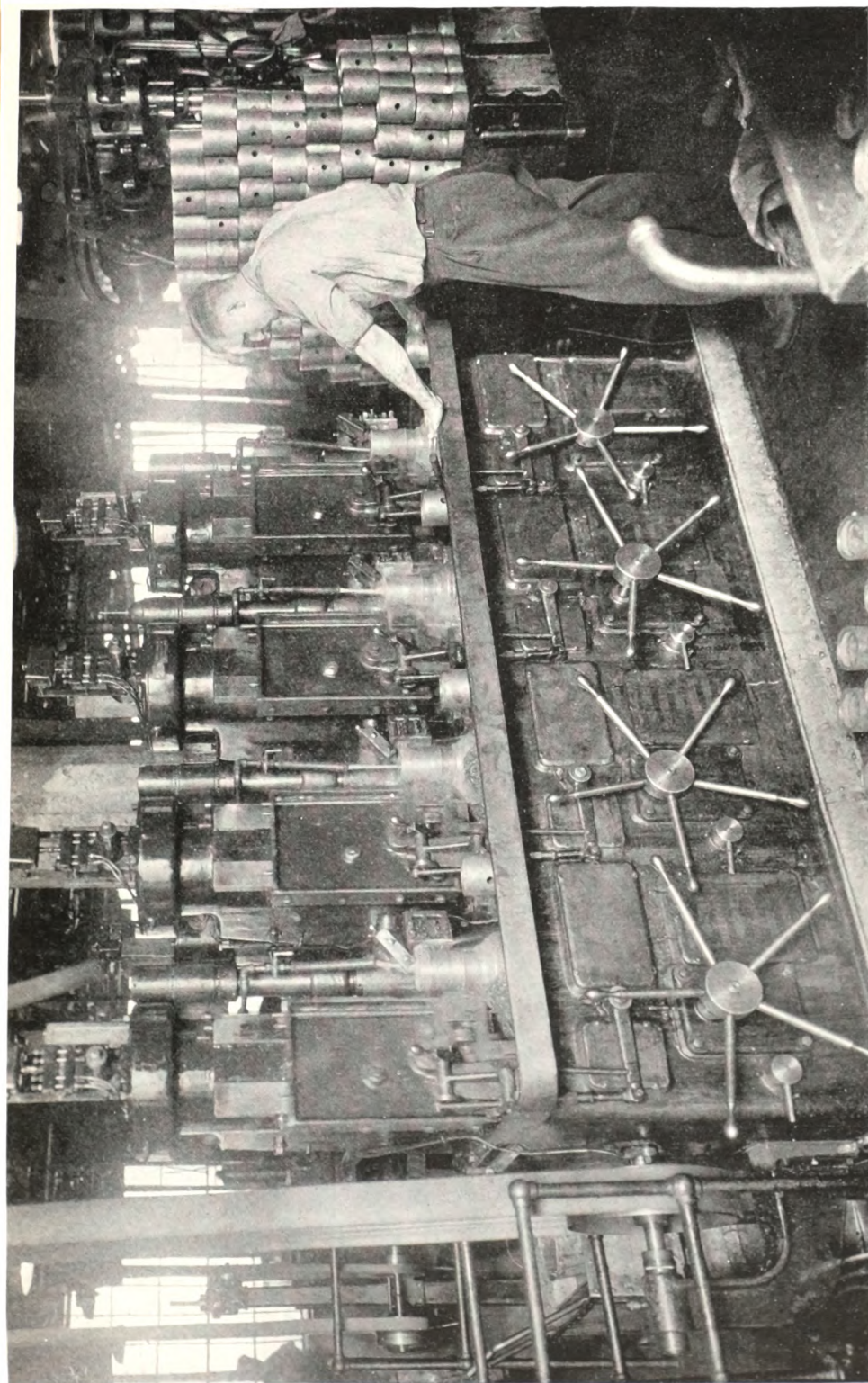




AN AUTOMATIC HIDE-MEASURING MACHINE

This mechanism is able to compute instantly the square footage of a hide with all its irregularities. As the hide passes through, every square inch is automatically noted and the total registered on the dial in front of the operator.





A MACHINE THAT FINISHES FOUR PISTONS ON THE TOP AND SIDE WALLS SIMULTANEOUSLY

George Baldwin Selden, of Selden patent fame, probably lost untold millions by a simple little diary entry. His patent was applied for nearly two decades before the building of the first successful American automobile, but was not issued until years after. When he saw what is now the accepted type of four-cycle motor, he wrote, "Another of those d—d Dutch engines." On that entry the courts held he was not thinking of such an engine when he patented his vehicle, and therefore that the building of the modern motor car did not infringe his patent, although it was valid for other types of engines.





© Underwood & Underwood

A VIEW OF CHARLES STREET, BOSTON, WITH THE COMMON ON THE RIGHT AND THE  
PUBLIC GARDEN ON THE LEFT

The passing of the day of putting down the tops of touring cars is to be noted wherever cars  
are parked.



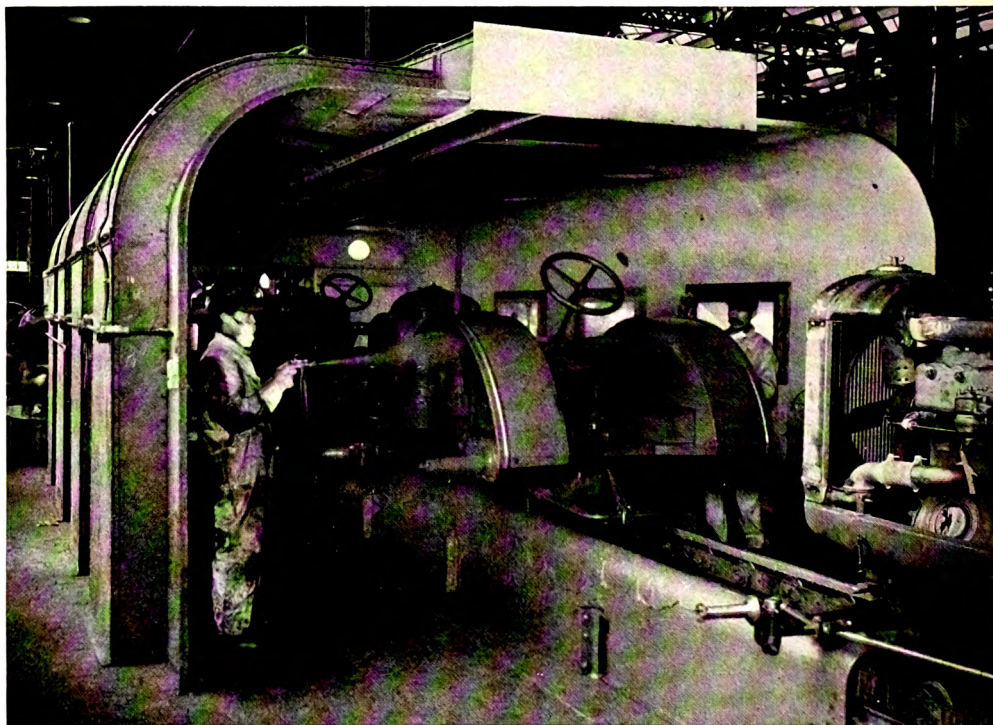


© Ewing Galloway

MOTOR TRAFFIC ON FIFTH AVENUE, NORTH OF 42ND STREET, NEW YORK: A NORMAL SCENE AT ANY HOUR OF THE BUSINESS DAY

"Some 42,000 motor vehicles pass the crossing at Fifth Avenue and 42nd Street every twenty-four hours; 4,500 in a single busy hour is not an unusual occurrence" (see text, page 361).





PAINTING WITH COMPRESSED AIR IN A TRACTOR PLANT

By the time the tractor reaches this booth on the assembly line, everything is in place except the wheels, which are put on just beyond the paint booth. Gray paint is sprayed on by compressed air. After the wheels are put on, the line passes through a drying tunnel 110 feet long, in which the temperature is maintained at 150 degrees.

And well they may! Consider what a present-day model automobile is. Its engine might be likened to a Gatling gun capable of propelling itself a mile a minute and, if it be a "six," of firing nine thousand shots a minute in doing so, without noise, undue heat, or disturbing wear, but rather with a smooth hum or a peaceful purr that is music to the ear of the motorist. A "four," even at twenty miles per hour, fires two thousand shots a minute.

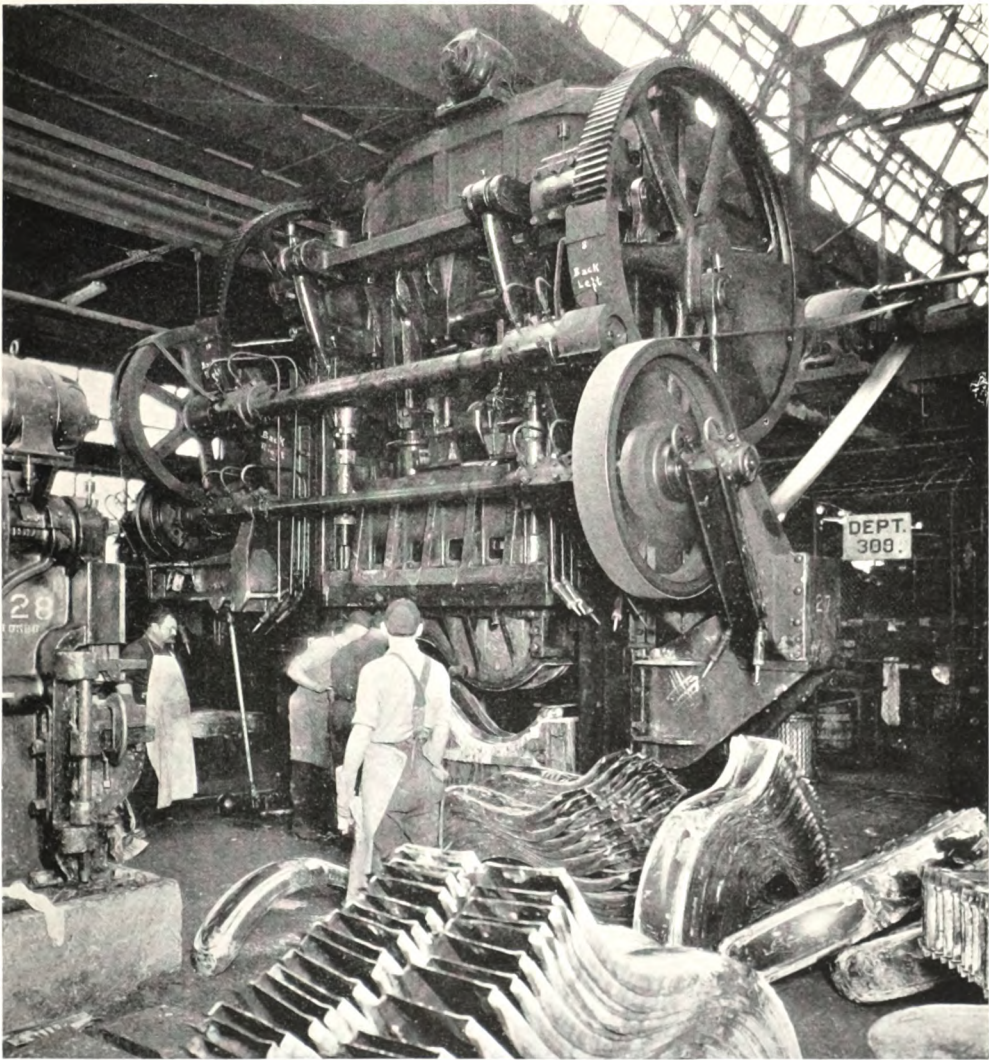
The crankshaft must do three thousand full turns in the average car to carry it a mile, and each piston must make six thousand trips through its cylinder, with a stop between each of them, in making that mile. At sixty miles you ask each valve to open, admit the live, or discharge the dead gas, and close again, in  $1/200$  of a second. And they are expected to do it with clockwork regularity.

The car also brings to its owner an individual light-and-power plant with which

he may start his car and light his path. It gives him a clutch that lets him make or break the power between his engine and his car at will and in a twinkling; a gearshift that lets him choose between power and speed and makes the change in a moment; brakes that give him complete control of a ton and a half vehicle with a slight pressure of the foot or a light pull of the hand. It furnishes him with tires made of a rubber composition nearly three times as durable as leather and fully three times as resistant to a sand blast as iron.

Compared with any previous instrument of transportation, the automobile is a wonderful device. A railroad engine, made to run over the smoothest roadbed in the world and with comparatively slow-moving parts, must be overhauled at the end of every run. On the other hand, given gas and oil, grease and water, in proper quantities, the "trusty old bus" will hum along for two hundred miles a day,





A STAMPING PRESS THAT COMPLETES FIVE FENDERS A MINUTE

This great machine turns out 2,700 fenders per day, one fender at each stroke. So accurate is the operation that the fender requires no further finishing touches, but is ready to be enameled as soon as the pressure of 225 tons is removed.

willing to give you, if it is a "six," more than half a million flywheel revolutions, nearly two million sparks, and more than seven million piston stops and starts, and be ready to repeat the performance on the morrow and many other morrows.

#### PROBLEMS THAT REMAIN TO BE SOLVED

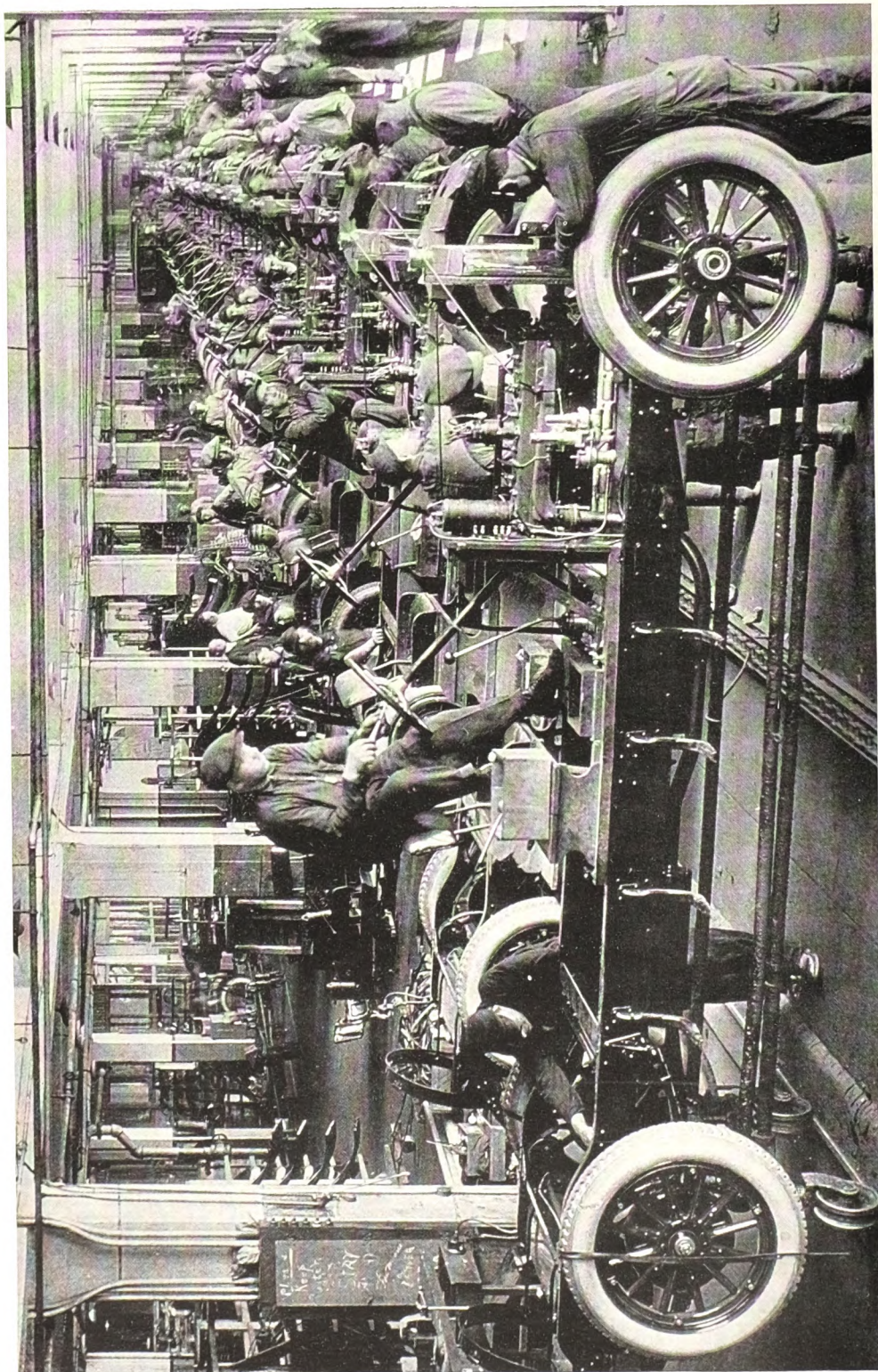
Yet, far as our automotive engineers have gone in making a dependable, fool-proof, vibration-defying, long-lasting motor car, they realize that much distance remains yet to be traveled before the goal

of excellence they are striving for can be reached.

To begin with, our engines to-day deliver us only ten cents' worth of power for every dollar's worth of gas they burn. Their pistons must travel twenty inches, on the basis of one explosion to every four strokes, to deliver five inches of push to their load.

Likewise, our cars ask us to move from 400 to 5,000 pounds of dead weight per person carried, depending on whether they be loaded "flivvers" or big sedans





THE FINAL ASSEMBLY LINE IN A BIG AUTOMOBILE FACTORY

When cars were first built, all the parts were simply dumped in piles on the floor. Now a frame starts down one line, an engine block down another, a transmission and rear axle down others. When they all meet, they have each been assembled and are ready to be united into a completed chassis on the final assembly line.





FINISHING THE METAL WORK ON THE BODIES OF A QUALITY MAKE OF CAR

Such bodies as these require about a hundred days from raw material to finished product. The new steel, baked-enameled bodies go through the factory in less than two days (see text, page 373).





FACTORY TESTING OF SPEEDOMETERS

Before being packed, speedometers are given a final test for accuracy by running them at different speeds on a testing machine. This is the last of the 557 inspections given each instrument and its parts in the course of its construction.

with only the owner inside. These and other items in the present car's make-up stand as a perpetual challenge to the automotive engineer, and he is addressing himself vigorously to the task of correcting them.

#### RUNNING DOWN THE "KNOCK"

When cars were first made, the builders simply bored holes in blocks, put pistons in them, and had engines. They had only

a general idea of what happens when a spark is applied to a compressed charge of gas in an engine cylinder. When the explosion took place under high compression, there came a knock that seriously reduced the engine's efficiency. All sorts of explanations for this knock were offered.

Then Mr. C. F. Kettering and his associates of the General Motors Research Laboratories decided to look into cylin-



ders and see what does actually happen when a spark ignites a charge of gas.

They built a glass engine, and through its walls were able to see what occurred. They found that in an explosion under high compression there is a secondary detonation whose energy waves move seventy times as fast as those of the primary explosion. It is the conflict of these two series of energy waves that makes the power-destroying "knock."

How to overcome this detonation became the next problem. The whole list of elements and compounds known to the laboratory was gone over and every one that offered any hope was tested. It was finally found that by adding tetra ethyl lead and a second compound in the proportion of about five thimblefuls to the gallon the secondary detonation was entirely avoided, and smooth running, even under the high compression beyond the control of a retarded spark, was made possible.

It has been found that the new combination makes five gallons of gasoline do the work of six, and the engineers assert that by reducing the size of the cylinder and the stroke of the piston it will be possible to produce higher-speed engines that will more than double the present mileage obtained from a gallon of gas.

On the other hand, there are engineers who say that while this will make possible the saving in gas, it will result in a corresponding wear on cylinder walls by the increased distance the pistons must travel to produce a mile of transportation.

The reduction of weight in cars is a very important item in the future plans of automobile design. One noted manufacturer says that unnecessary weight is as useless in a car as a cockade on a coachman's hat, if not more so, since the cockade at least serves the purpose of identification. The reduction of weight means smaller motors, lighter axles, and less cumbersome frames and running gear, all of which promise less expensive tires and decreasing operating costs.

#### OVERCOMING THE NECESSITY OF WATER-COOLING

One of the new departures in engine design that serves to reduce weight is the substitution of copper-cooling for water-cooling. The function of water in an

automobile engine is to carry the heat from the cylinders to the radiator cells, where it is released by radiation.

For a long time, at least one manufacturer has been able to produce an air-cooled engine, with iron fins surrounding the cylinders, that has stood up well in every-day service. The engineering textbooks all declare that it is impossible to fuse copper and iron in a commercial way. However, at least two manufacturers have succeeded in doing so, and two cars are now on the market with copper cylinder jackets which claim to give radiation efficiency fully up to the standard of the modern water-cooled system.

Copper, being much more efficient as a heat-radiating medium than iron, makes an ideal substitute for water, eliminating radiator repairs, freezing dangers, etc. The copper-cooled engine weighs less by about 130 pounds than a water-cooled engine of similar horsepower and cooling efficiency.

#### ANTI-FRICTION BEARINGS

One of the prime causes of short life in motor cars is neglect in the matter of lubrication. Owners of fleets of cars, notably some of the taxicab companies, get from 200,000 to 300,000 miles out of a machine. The owner of an individual car considers that he has done well when his odometer registers 50,000 miles. His neglect of lubrication is more frequently responsible than any other one item for his low mileage.

The General Motors Research Corporation has been working on the task of producing a nonfriction bearing, and demonstrations at Dayton point to complete success. Instead of melting the metal and molding the molten fluid, it is powdered, put into the mold in that form, and subjected to heat. The alloy has a lower melting point than the steel itself and thus is made a homogeneous part of the material. When taken out of the furnace, the bearing has a certain porosity not present in bearings molded in the orthodox manner. It is capable of absorbing a certain percentage of its weight in lubricants.

Under dynamometer tests these bearings have been run at 2,000 revolutions per minute, which is equivalent to a speed of the crankshaft of a car running 40 miles





DOUBLE-DECKING FLAT FREIGHT CARS FOR BIG MOTOR-CAR SHIPMENTS

Despite the fact that a third of a million carloads of cars were shipped from factories last year, and 75,000 more from assembling plants, and still other thousands by Great Lake steamers, it has been necessary to send many cars to distribution centers in drive-away fleets. One manufacturer maintains a corps of drive-away men, sending the cars out in fleets of ten, each with a captain and a mechanic. Drivers are not allowed to raise the hoods of their cars and must keep their assigned positions in the fleet. The speed is held down to 25 miles an hour.



an hour. Although told that they had been running for 3,600 and 3,700 hours without stop, they were still cool enough for me to bear my hand on them when I examined them.

With frictionless bearings, burned-out bushings will probably be a thing of the past. The antifriction element in them will be used mainly to counteract neglect. It will be the savings-account funds of car operation—not to be drawn on except in emergency.

#### THE STATUS OF STEEL BODIES

Engineers predict that the automobile bodies of the future in all quantity-production cars will be steel. Not only does metal construction reduce the time required for the completion of a sedan body from more than one hundred days to less than two, but it also makes a more lasting job.

Instead of glue and screws with which a wooden body is put together, electric welding and rivets are used, which make for permanency. It is the difference between the modern all-steel Pullman car and the old-fashioned coach of wood construction.

Baked-on enamel, applied in a few hours, if correctly put on, shows much more durability than the best hand-painting, which requires eighteen days or more. The enamel does not deteriorate, but, owing to atmospheric and temperature conditions, merely collects a residue of blue scum that is readily removed with a proper polish. A report of an enamel job done in 1914 was made at a recent meeting of a branch of the Society of Automotive Engineers. Good care had been taken of the car; it had been polished and kept clean, and in 1922 appeared practically as new.

#### MEETING THE DEMAND FOR ACCESSIBILITY

The motorist of the future will demand accessibility of parts. The important thing with taxicab companies is the keeping of their vehicles out of the shop and in the streets. Therefore, accessibility of parts is a sort of religion with the leading manufacturers of taxicabs.

Bolts and nuts must be so located as to insure ease and rapidity in removal or installation, and parts must be quickly exchangeable.

So thoroughly has the construction of a standard type of cab been simplified that twenty minutes is now the time allowed for the replacing of a spring, forty minutes for the removal of an engine, and fifty minutes for the reinstallation of an engine.

The introduction of the flat rate in service charges, whereby each operation is done at a factory-fixed rate, is destined to hasten the simplification of car design, for the manufacturer who can make a car simpler for the repair man than his competitor can give a lower rate for service, and this will be one of the standards by which the future buyer will determine who will make his next car.

A leading taxicab manufacturing company, with its vast fleet of cars in operation and its detailed cost-keeping system for car operation, is doing much to guide the industry toward the production of cars whose maintenance costs will be lower.

#### THE ADVANTAGES OF SUPER-SIZED TIRES

It has been found that vibration is the worst enemy of an automobile, and this evil has been attacked from many angles.

One line of investigation has been in the reduction of tire-inflation pressure. In pursuing this investigation it has been found that by the further extension of the oversized tire principle, inflation can be reduced from the sixty or eighty pounds pressure to thirty and forty pounds.

One taxicab company is having tires made with wider treads. This has been carried so far that some of the tires look like big, fat sausages. But the reduction of vibration due to their softness has shown amazing results in cost of car upkeep and even in car life. The tires are built with thinner walls, and through their ability to take the minor shocks of the road more easily, their mileage is lengthened to such a degree as to compensate for their higher cost, leaving both the car protection and ridability as dividends on the investment.

Skidding is reduced to a minimum with these super-sized tires, brake control is made more complete, and muddy roads are robbed of many of their terrors. Steering is not noticeably more difficult at ordinary speeds, though admittedly





Photograph from F. C. Doig

## THE LAKE CRESCENT ROAD, AMONG THE FINE FIRS OF THE STATE OF WASHINGTON

A proposition is now being advocated to give the North Coast people a bridge entrance into San Francisco. A territory as large as the State of Rhode Island would thus be thrown open to settlement. It is proposed to charge a bridge toll of \$1.18 per car and 15 cents per passenger or pedestrian. The bridge would be about 7,500 feet long. In 1921, 200,000 cars were handled on the Golden Gate ferry.





Photograph from De Witt V. Hutchings

## ARRIVING BY MOTOR FOR THE RUBIDOUX EASTER SERVICE, RIVERSIDE, CALIFORNIA

it is somewhat harder at slow speeds, as is the turning of the front wheels when the car is standing still.

The coming of the super-sized tire will result in a smaller wheel—a wheel, indeed, not much larger than some of the brake drums now in use. It may mean a slight lengthening of the axles in order to maintain the present turning radius, though, on the other hand, it may be decided to concede a little in turning radius in order to maintain the present axle-length.

## FOUR-WHEEL BRAKES A NEW DEPARTURE

With the increasing use of automobiles increased control of the individual car is demanded. To be able to bring a car more quickly to a standstill sometimes means the avoidance of an accident. Four-wheel brakes are beginning to make their appearance in this country, and have been found to cut practically in half the distance required for bringing a moving car to a stop. Many manufacturers believe, however, that the super-sized

tires will give the requisite braking efficiency without resorting to four-wheel brakes.

## WHO SETS THE FASHIONS IN MOTOR-CAR DESIGN?

Automotive engineers are giving more and more attention to what they call the passenger accommodations — everything above the chassis. While the body and its accessories have little to do with the mechanical merit of the car, they have a vast deal to do with the sale demand.

And this, in turn, throws some light on the question of who sets motordom's fashions. A manufacturer making an assembled car on a small scale brings out something new in body design—say, a new sport model. It has various little touches that please the eye and promote the comfort of the passenger.

When it goes before the public, many buyers forget the fact that the value of a motor car is mainly in the chassis, and make a selection without considering that phase of the subject.

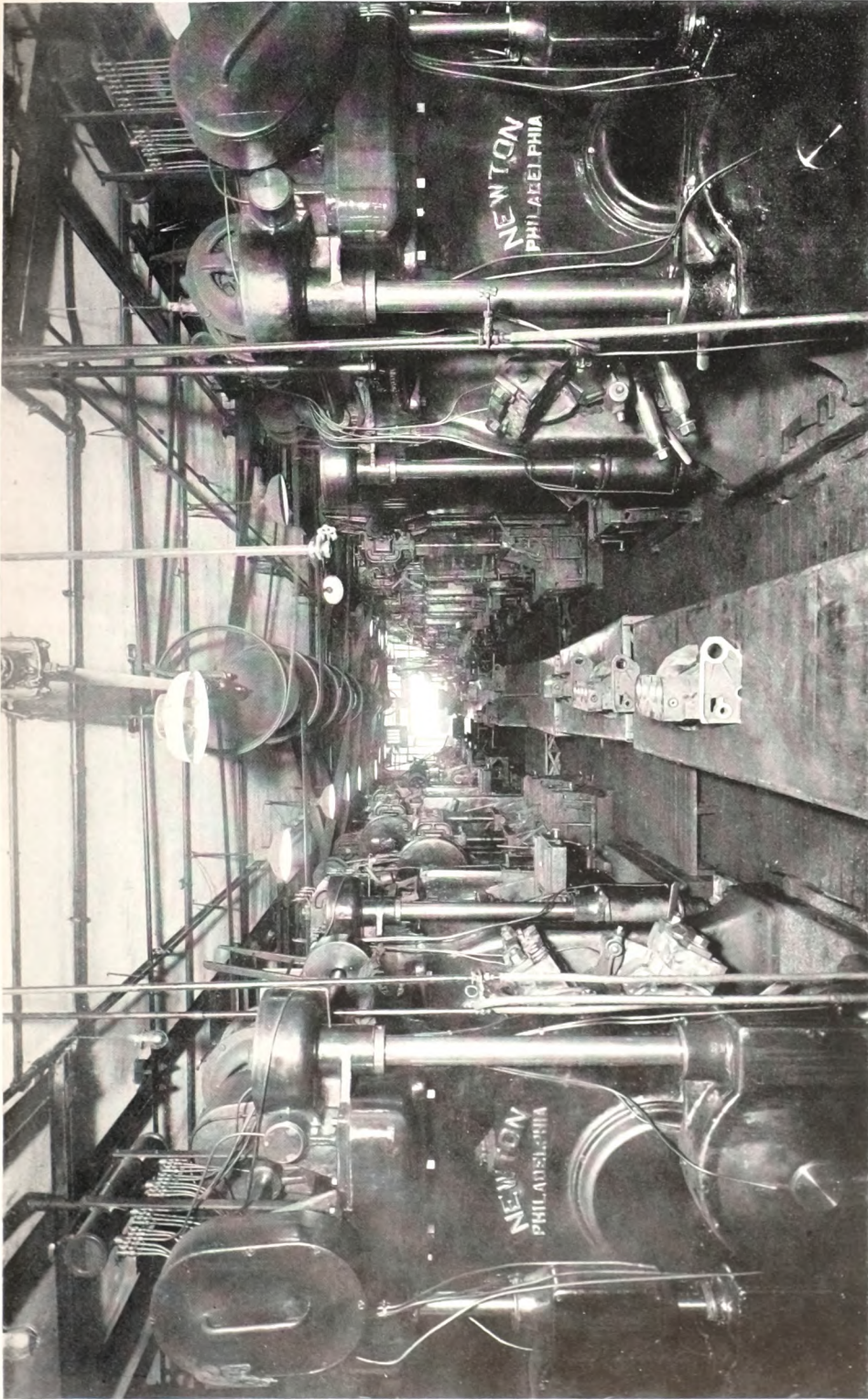




THE CYANIDE OF POTASSIUM FURNACES IN A DETROIT MOTOR-CAR PLANT

Heat-treating and case-hardening have done a vast deal toward making the automobile stand the strains to which every-day usage puts it. This one plant uses enough cyanide every day to destroy the entire population of the New World (see text, page 400).





ONE OF THE REASONS WHY PEOPLE OF MODERATE MEANS CAN AFFORD GOOD CARS

In the elimination of lost motion, automobile manufacturers are ever on the watch for improvements. In the machining of engine blocks older installations take one block at a time, put it on a bed and move the cutting tool back and forth over it, with each backward movement an idle one. The machine here takes a half dozen blocks and rotates them past the cutting tool, eliminating the idling back motion. Reduced cost of milling engine blocks is the result.





© Underwood & Underwood

HANGING ON BEHIND: THROUGH A FORD IN ROCK CREEK PARK, WASHINGTON, D. C.

A Michigan lumberman invented the modern spark plug; a Russian Jew, the demountable rim; a mid-western engineer, the orthodox self-starter; and a New England Yankee, the antiskid chain—a quartet of inventions that has been a major factor in the development of motoring in America.



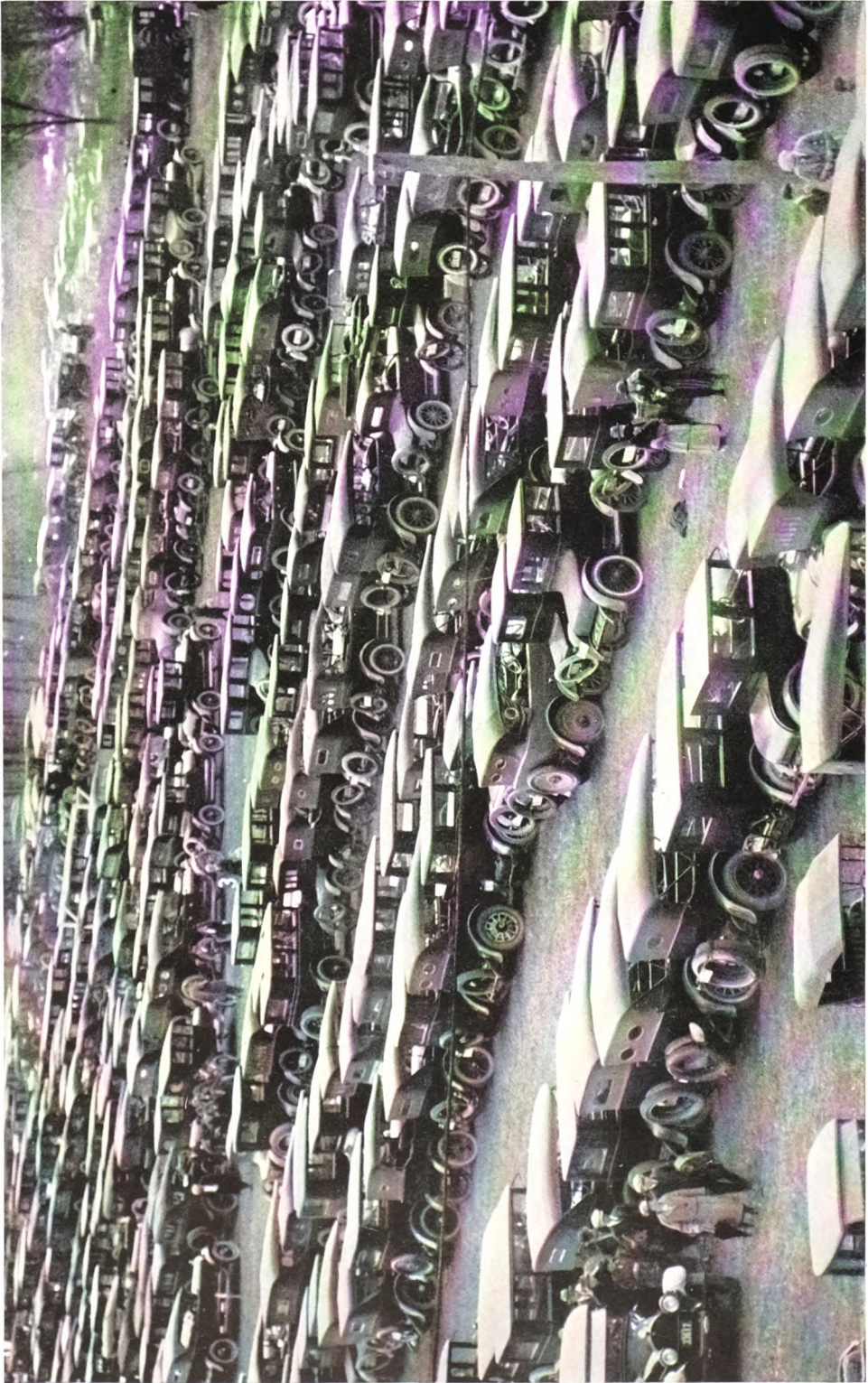


© Ewing Galloway

# HEAVY GOING IN THE WAKE OF A RAINSTORM IN THE CEDAR BREAKS REGION OF SOUTHERN UTAH

It is estimated by the National Motorists' Association that two and a half million car-owners annually take to the roads of the country for a vacation, and this number represents about ten million tourists.





Photograph by International Newsreel  
THEIR OWNERS ARE WATCHING THE YALE-IOWA FOOTBALL GAME; THIS PICTURE WAS TAKEN NEAR THE YALE BOWL



Then the staid manufacturer of a staple chassis that has stood the test of years finds that, if the new types are not to undermine his sales, he must meet the competition, and so he sets about to do so, with the result that a new fashion becomes a settled part of the industry.

#### WHEN MILADY SETS THE PACE FOR EASE AND SAFETY

Statistics have been gathered which show that the ladies have an unsuspected voice in the selection of the family motor car. This is causing most manufacturers to cater to their tastes with great care.

One company puts a thermos bottle in as standard equipment. Another makes his oil-draining system so easy of operation that a woman can drain the crank case without difficulty. Another groups the instrument-board equipment under one glass, so that the board can be kept looking like new.

Still another puts on an improved type of brake-equalizer, so as to insure, in a measure at least, Milady driver against skidding. Gear shifting and clutch operation have been made easier to catch her eye. Accelerator pedals have been redesigned, so that they function equally well with high-heeled dress boots and low-heeled sport shoes. Spark and gas control levers on the steering wheel are being redesigned to obviate the danger of feminine fingers being caught between the control sectors and the steering-wheel spokes when turning corners, and to lessen the risk of stray ends of the woman driver's finery being torn in the control mechanism as she drives to the next bridge party.

One manufacturer provides for automatic rekranking in case she stalls her engine, and another takes steps to insure a better mixture in a cold engine or in a sudden acceleration of the motor.

#### TAKING YOUR BED WITH YOU

In an attempt to capitalize America's love for camping out, one car builder has announced a model in which the Pullman berth idea is copied. Press a button and the back of the front seat drops down. Reverse the cushion on the rear seat, and lo! you have a bed inside your car! Tents eliminated, you are ready to make your bed wherever night

overtakes you—by a babbling brook, under a fine willow, or wherever fancy dictates.

The maker of a standard, medium-priced car was asked what he thought would be the future trend of car design for the masses. He replied that his factory was working toward the time when it would put out a model weighing about 1,800 pounds and accommodating four instead of five passengers.

In no other field does one find such close coöperation as in the motor-car industry. The manufacturers in the early days were forced to unite for the purpose of fighting hostile legislation and for making the American public motor-minded. They found that they could make a better market for their individual cars by teamwork with their competitors in selling the car idea. They learned that their success was linked with their competitors' success.

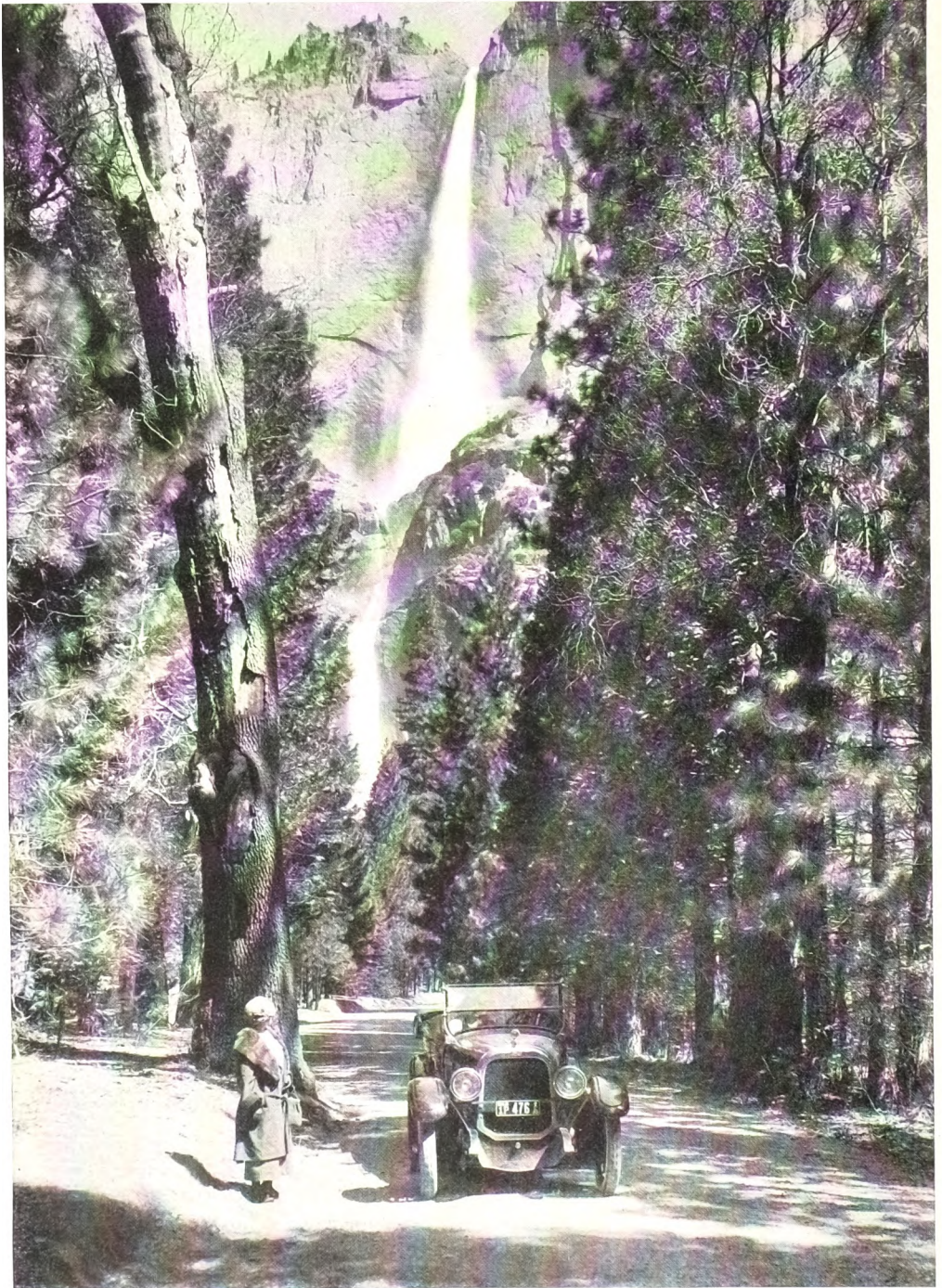
#### "COÖPERATIVE COMPETITION"

So "coöperative competition" became their watchword. Young, virile men with imagination made this policy a tremendous success, so much so that they agreed among themselves to form a pool of ideas. In this pool there are about 500 patents, and every member of the National Automobile Chamber of Commerce, which includes practically all the leading manufacturers, voluntarily agrees to let every other member use any or all of the features of construction and equipment owned by them individually without the payment of royalties or other compensation. They hold that the better service all cars render the greater will be the demand for their own.

One of the interesting organizations within the industry is the Society of Automotive Engineers. Its main purpose, when organized, was to promote standardization among manufacturers, but it has found its principal continuing mission to be that of a research body serving as a clearing house in automotive engineering and design development.

Standardization has been a big task. The fixing of metal standards has assured a consistent and dependable product to the discomfiture of foreign manufacturers. Sizes in wheels and cotterpins, threading of spark plugs, details of tire



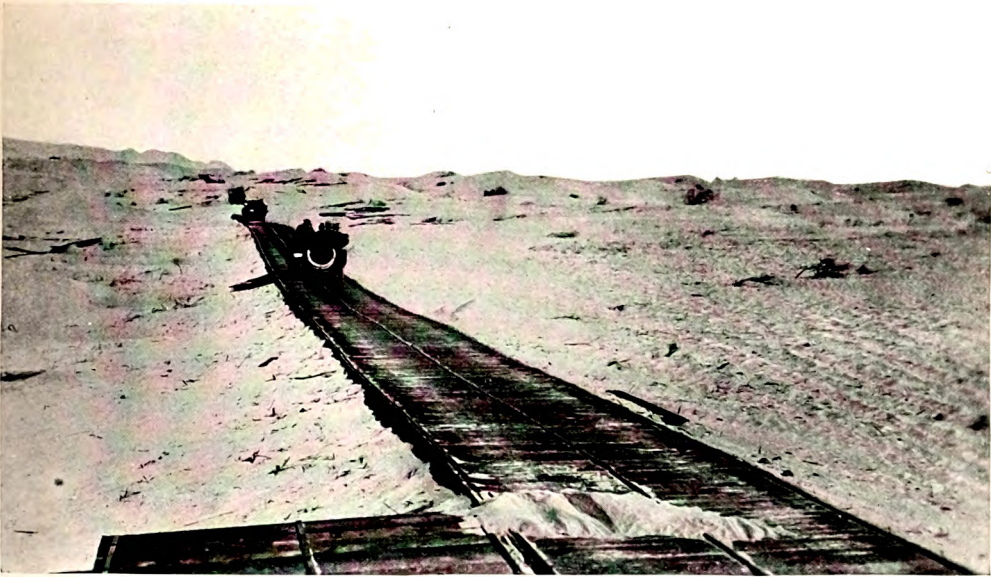


Photograph by Charles M. Miller

## AT THE FOOT OF YOSEMITE FALLS: YOSEMITE NATIONAL PARK

It is only a little more than twenty-five years ago that the first sale of an automobile was made in this country. The National Motorists Association estimates that more than 2,500,000 car owners will this year use the automobile highways in visiting America's many points of interest.





A COMPLETED STRETCH OF PLANK ROAD OVER THE CALIFORNIA DESERT

Note the turnout in the left foreground. These are built at frequent intervals. Such a road would not be practical where there was excessive shifting of sand dunes.

fastenings, angles of valve-seating, and scores of other items that could be made to fit all cars without detracting in the slightest degree from the engineering originality in car construction that differentiates one car from another, have been standardized, and this standardization lies at the base of quantity production, which, in its turn, plays a fundamental part in American supremacy in the automobile field.

It was found that one company making lock washers for the automobile manufacturers was obliged to make 800 different kinds of washers for bolts ranging from three-sixteenths to one-fourth of an inch in diameter.

It was likewise discovered that the automobile manufacturers were using 1,600 different sizes of steel tubing. Standardization has reduced the number of sizes of washers and tubing to a minimum, with saving in cost of manufacture, reduction of inventory, and convenience to the public.

#### HOW AUTOMOBILE RACING GIVES THE PUBLIC BETTER CARS

In the early days automobile racing was indulged in for the purpose of showing that cars could get over the road at

all, and such races as that sponsored by newspapers in 1895 seem ludicrous at this distance.

Later, people began to think of speed. They wanted cars that could make thirty miles an hour, and the car that showed the most speed was the one that found the readiest sale.

In one of these races for advertising purposes, Henry Ford himself took part in a contraption he called the "Arrow." He undertook to run it a mile straight-away over the ice. The ice looked smooth, but when he got up speed he found it was covered with fissures. To call off the race would be throwing his advertising into reverse gear. So, in his words, "I let the old 'Arrow' out. At every fissure the car leaped into the air. I never knew how it was coming down. When I wasn't in the air, I was skidding, but somehow I stayed top side up and on the course."

Some years later road racing came into vogue, and it did a vast deal in the development of motors, the evolution of spring design, the perfection of ignition, and the solution of lubrication problems.

After the road races came the reliability runs, made under conditions that found the weak spots in the stock cars





Photograph by Pacific and Atlantic Service

THE OREGON STATE MOTOR ASSOCIATION PLANS TO TAKE OREGON SCENERY ABROAD

The back of the Association's pathfinder car is being painted with a scene showing Mt. Hood, with the city of Portland in the foreground.

put under test, and they, in turn, served to shake down engineering standards to the level of dependability.

But later came the speedway races. To them came the best ideas the ablest engineers in the world could evolve, to be put to the grueling tests that only a speedway race can set up. The first speedway built was at Indianapolis, with James A. Allison, A. C. Newby, and Carl G. Fisher as the moving spirits in its construction.

The roadbed was built of earth, like a country highway, but after the first test of 500 miles the conditions were found to be dangerous and unsatisfactory, and straightway it was rebuilt of brick and made to simulate street conditions. No car ever entered one of the races thereafter and went through the grueling test without revealing its weak points.

Every automotive engineer in the profession seeks to know as fully what to

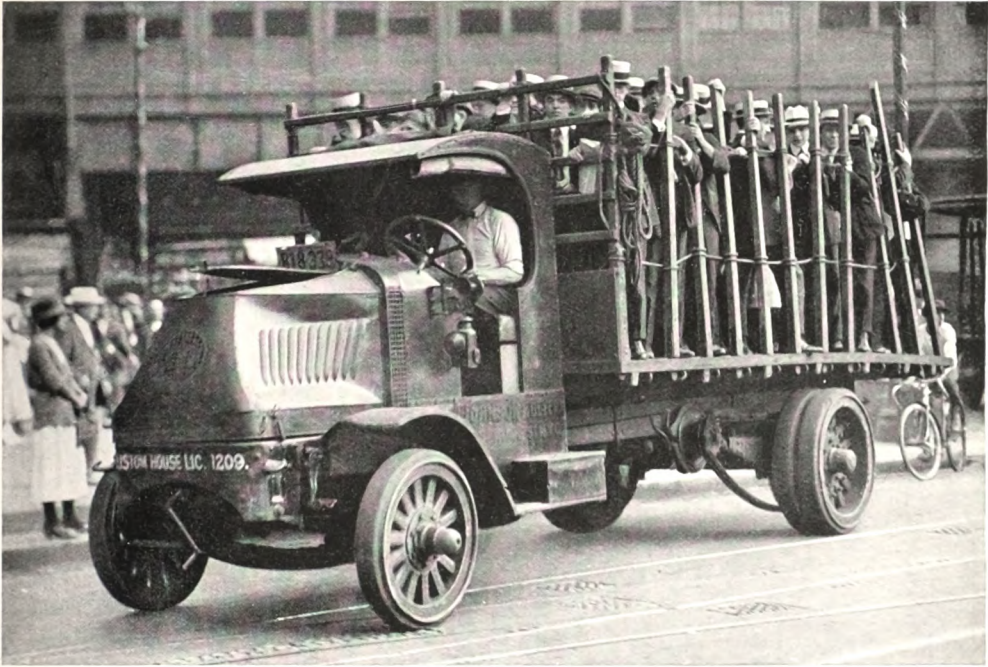
avoid as what to incorporate in his future models. The result has been that these terrific tests at Indianapolis have always brought the engineering talent of the country together.

Under the lessons learned there—and obtainable in no other manner, since bench tests cannot develop road conditions—cylinder displacement has been reduced, fuel economy has been evolved, and safety has been forged into every element of your motor car and mine on the mighty anvil of a speedway and under the powerful hammer of high speed. Harmony, balance, dependability, tire mileage, and sturdiness have come from the flaming forge of a hundred miles an hour (see illustrations, pp. 344 and 345).

THE ROMANCE OF QUANTITY PRODUCTION

Quantity production is, after all, the foundation stone upon which rests the





#### MOTOR TRUCKS PROTECT THE PUBLIC DURING STREET-CAR STRIKES

In many cities motor cars have helped the public get down town when the street-car service has been interrupted.

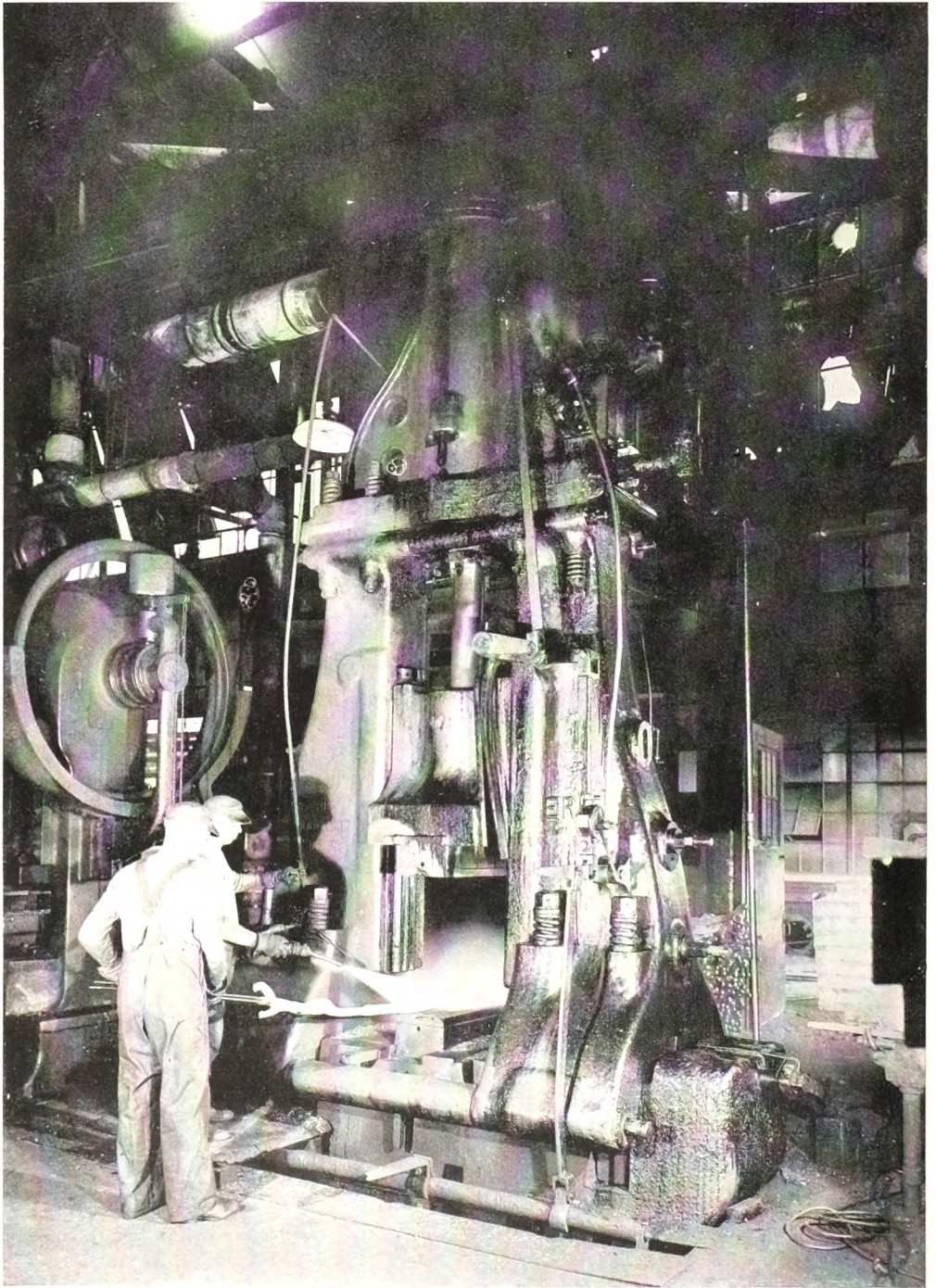


Photographs by Paul Thompson

#### HAULING PULP WOOD IN THE MAINE WOODS

By combining truck, tractor, and bob-sled, the Maine lumbermen have found a practical way to move pulp wood, used in the manufacture of paper, over the ice and snow in winter.

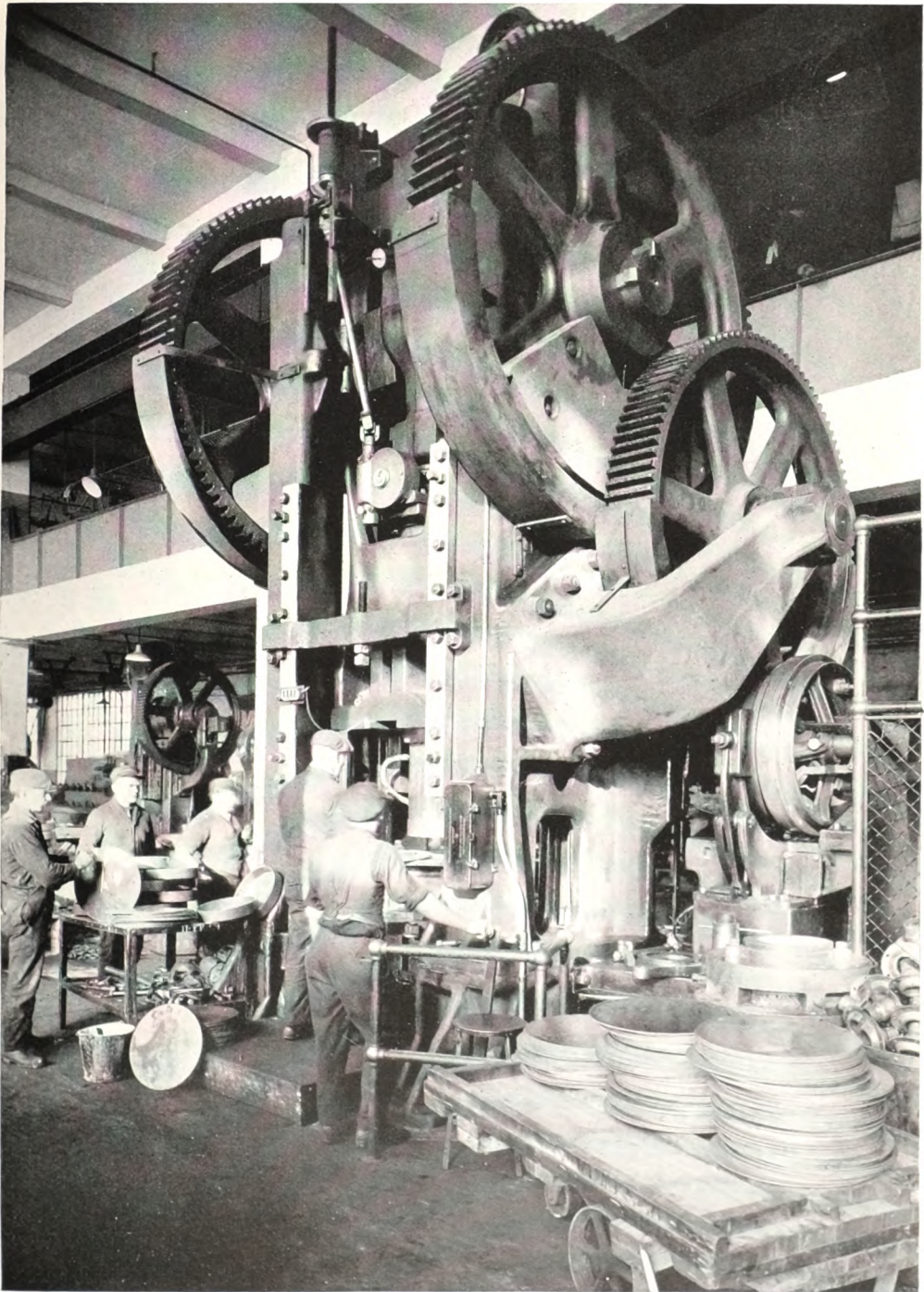




DROP-FORGING A FRONT AXLE

After the heat treatment the axle ingot comes to this big, four-ton hammer and is forged into shape. This machine can be so delicately operated that it can be made to tap a watch without breaking the crystal (see text, page 400).

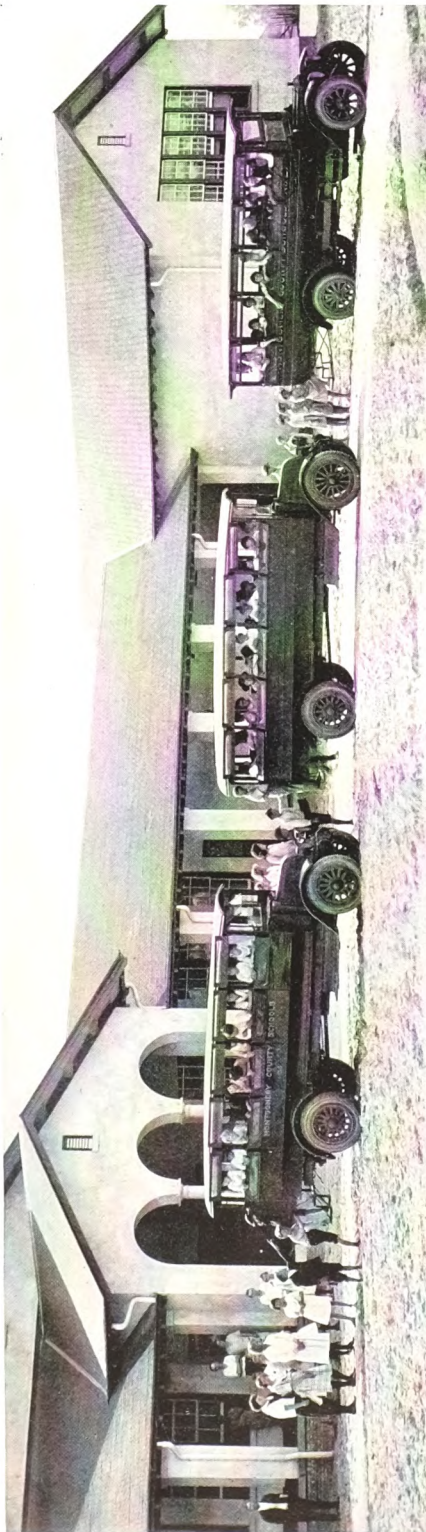




THE TYPE OF PRESS THAT MAKES BRAKE DRUMS

The flat disks from which the brake drums are made are cut out of sheet steel like cookies out of dough. They are then fed through the machine here shown and are pressed into drums, as shown at the left.





STUDENTS LEAVING THE PINE LEVEL, ALABAMA, JUNIOR HIGH SCHOOL

success of the automotive industry. Without it motor cars would certainly be beyond the means of millions of persons who now own them. In the early days they were largely made by hand. Today the use of a paint brush or a pair of spanners, the movement of a lever, or the holding of an electric wrench represents about the limit of handwork in motor-car manufacture. That precision tools are superior to human senses in automobile making has been strikingly demonstrated.

#### CLIPPING MINUTES IN MOTOR MAKING

In the early days the material for the assembly of a car was simply dumped together in a space on the floor where the automobile was to be set up. Then the Ford Motor Company thought to try out the overhead trolley system used by the Chicago packers and a division of labor.

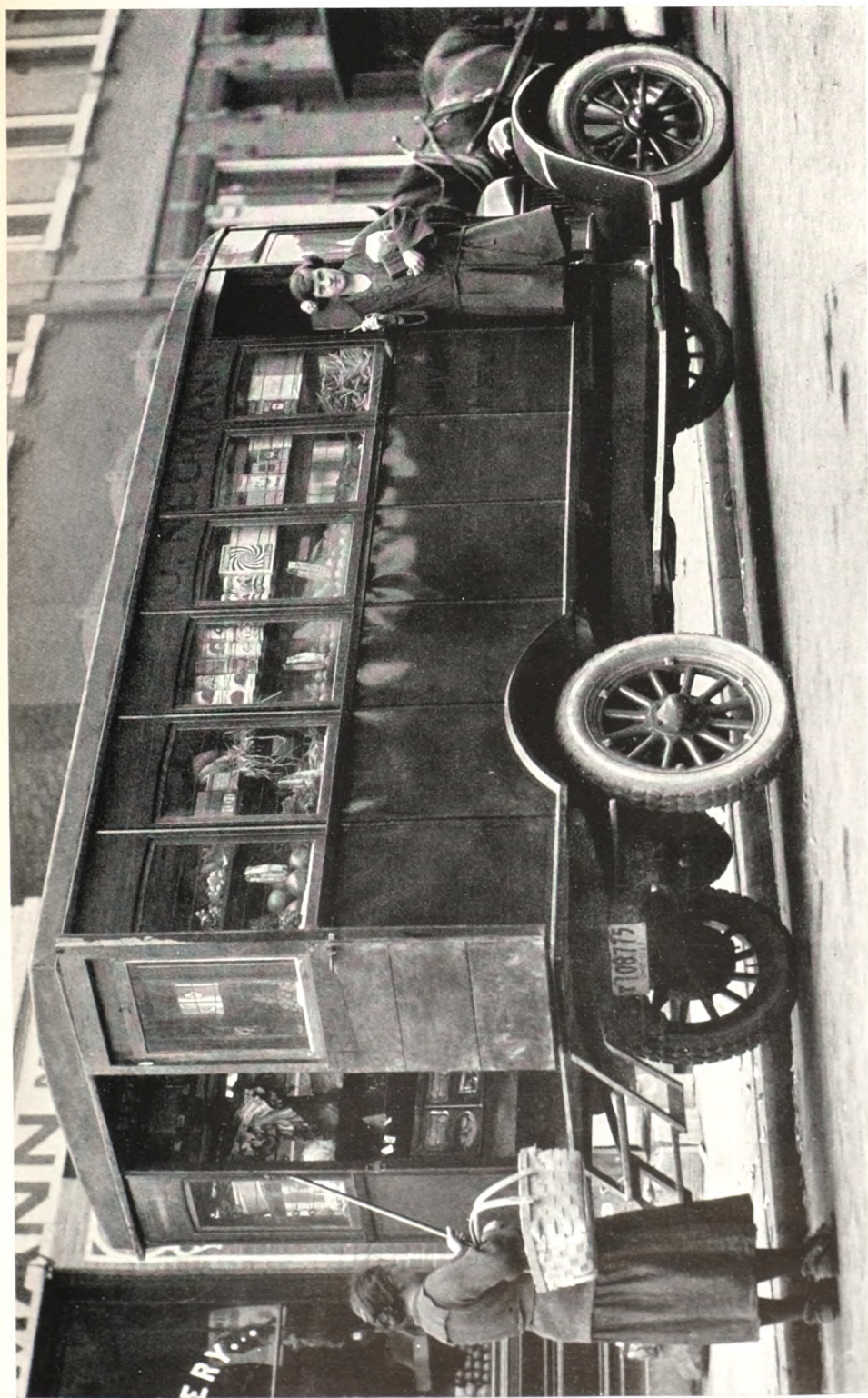
One man could assemble a flywheel magneto in twenty minutes. When the moving line was installed and divided into twenty-nine operations, the time was cut down to less than fourteen minutes. By raising the height of the line eight inches, so as to save stooping, the time was reduced to seven minutes. Other experiments reduced the time to five minutes.

In 1913, 9 hours and 54 minutes were required to assemble a motor in the Ford plant. Six months later the time had been reduced to 5 hours and 56 minutes.

By early methods 12 hours and 28 minutes was the time required to assemble a chassis. Then the idea was evolved of towing the chassis down a 250-foot line with a rope attached to a windlass. Six assemblers walked down the line, picking up parts from various piles and attaching them as the car moved. This speeded up the assembly to 5 hours and 50 minutes. By placing the work waist-high and bringing the speed of the conveyor to the most effective point, the time of assembly was reduced to 1 hour and 33 minutes.

It was quite a task to determine at what speed each conveyor should move so as to give each workman ample time to do his bit properly and yet economize every second. The flywheel magneto assembly line was tried at sixty feet a minute, and that proved too fast. Eighteen feet per minute proved too slow. Forty-four feet finally proved to be the correct velocity.





© Underwood & Underwood

#### NOW COMES THE TRAVELING GROCERY

A Cincinnati grocer decided to try a "help yourself and pay as you leave" store on wheels. He found the venture so profitable that he proposes to add other cars to his fleet.





© Underwood &amp; Underwood

## A PREACHER AND HIS PERIPATETIC PULPIT

A Brooklyn clergyman decided to fulfill literally the admonition to "go out into the highways." His traveling chapel has stained-glass windows, a small organ, and a steeple that can be lowered to permit passage into a garage.

In a leading plant the chassis assembly line moves at six feet per minute and has forty-five operations. The first man puts on the mudguard brackets, the motor arrives in the tenth stage, and so on. Some men do only one or two small operations. The man who places a part does not fasten it; the man who puts in a bolt does not put on the nut; the man who puts on the nut does not tighten it.

On operation No. 34 the motor gets its gas, having received its oil earlier. At station No. 44 the radiator is filled with water, and at No. 45 a button is pressed, a pair of rollers in the floor under the rear wheels begins to revolve rapidly, the wheels spin, the engine turns over, and the car glides away under its own power with a driver at the wheel.

Going back a little, the molding in the foundry is all done by machinery. A line is adapted to the making of a single type

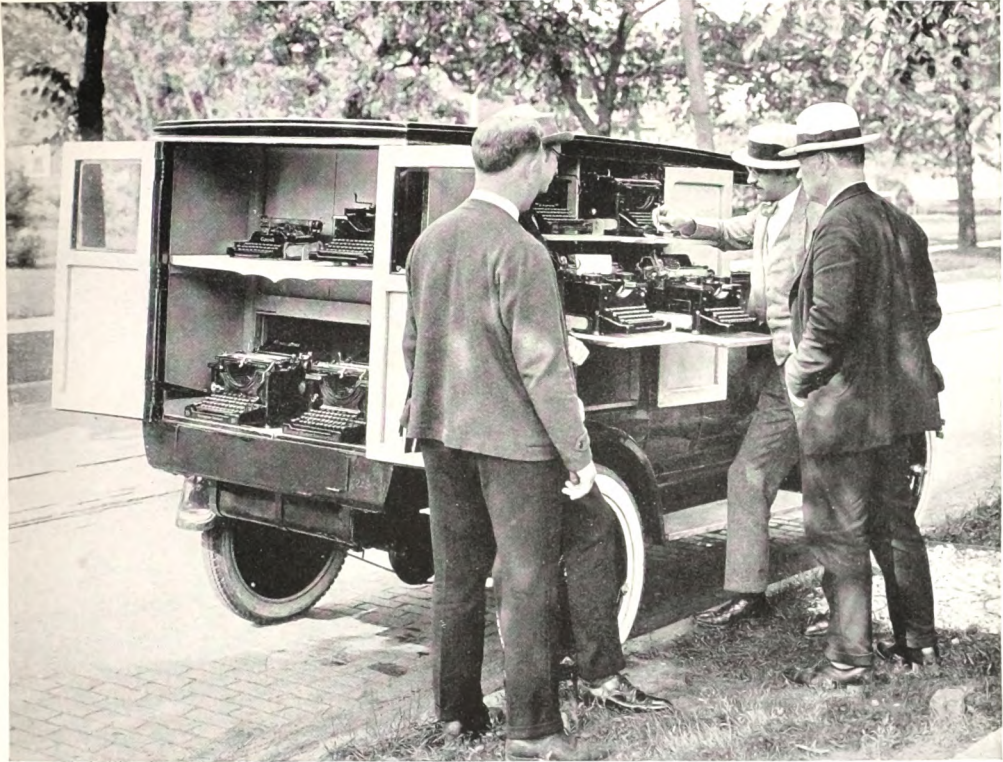
of casting. In the casting of the engine block there are three lines with a capacity of 5,000 blocks every eight hours, or 15,000 when working three shifts a day. The making of the molds and cores and the packing of the cores are all done while the line moves. At another point the molten metal is poured, and by the time the mold reaches the end of its journey, the casting is cool enough to start on its automatic way to cleaning, machining, and assembly.

## UNPRODUCTIVE STEPS ELIMINATED

The piston and connecting-rod assembly is another illustration of the elimination of lost motion in the industry. Under the old plan a man assembled twenty pistons and rods an hour, and subdivision of work didn't seem to promise much saving.

The workman pushed the pin out of





Photograph from E. E. Pierson

## A MOTORIZED TYPEWRITER SALES SERVICE

A Bloomington, Illinois, typewriter agency decided to send its salesmen on the road with a full line of samples. A specially designed automobile body was installed, and now the typewriter store travels from town to town and from office to office. Each machine is mounted on a board that can be pulled out and made to serve as a demonstration desk.

the piston, oiled it, slipped the rod in place, replaced the pin, tightened one screw and opened another.

Then came a foreman with a stopwatch. He found that four hours out of every nine were spent taking steps. He subdivided the work into three operations, eliminated unproductive stepping, and now there are 46 pistons assembled per man-hour.

Painting the rear axle was an operation that took two men several minutes; new machinery was devised, and now it is a thirteen-second job for one man.

With its ninety-five tubes, a radiator, even on a Ford, is a rather complex affair. Fitting and soldering these tubes by hand was a long operation, requiring many skilled men. Now a machine is in use which can make 1,200 radiator cores in eight hours, the soldering being done by moving the radiator through a furnace

on a metal conveyor, which entirely eliminates the tinsmith.

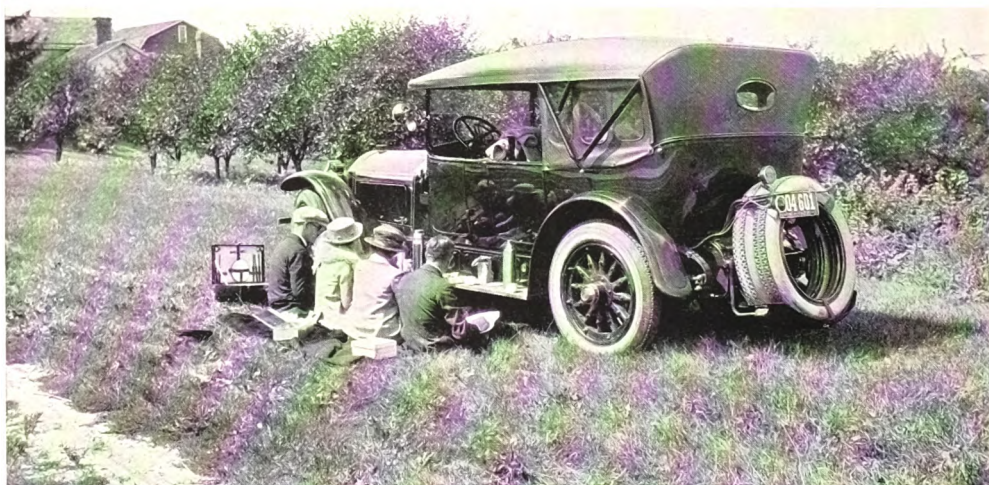
## SUGGESTIONS FROM THE RANKS

Suggestions come from everywhere in the average quantity production automobile factory, and especially from the ranks. In one plant a Polish workman who could speak no English found that if the tool in his machine were set at a different angle it would wear longer. That discovery saved thousands of dollars in tool-grinding. Another, running a drill press, rigged up a little fixture to save handling after drilling. Tens of thousands of dollars are saved annually by it.

A proposal that castings be taken from the foundry to the machine shop on an overhead conveyor saved seventy men in the transport division.

Seventeen men were required, when production was much smaller than now,





A WEEK-END ALONGSIDE ONE OF NEW YORK'S STATE HIGHWAYS



Photographs by George R. King

BUYING PEACHES ON A NEW YORK STATE HIGHWAY

Motorists in New York and New England find everything, from apples and peaches to eggs and jellies, offered for sale by the roadside; and the prices are usually surprisingly low.



to remove burrs from gears. A mechanic roughly designed a machine to do the work. It was perfected, and now four men have several times the output of seventeen, and none of them works as hard as any of their predecessors.

Another man suggested a welded rod instead of a solid one in the chassis, and the resultant economy meant more than half a million dollars a year in this plant. An improvement in heat-treating camshafts reduced the need of shaft straighteners from 37 to 8, although production has nearly doubled.

#### THE STORY OF THE GEAR-WHEEL DIPPER

Does the reduction of the intricacy of the work a man performs deaden his initiative or reduce the value of his work to the industry? Many people have asked that question.

In one factory I visited, perhaps the most monotonous task is that of a man who picks up a gear with a steel hook, shakes it in a vat of oil, and then places it in a basket. The monotony of the motion required never varies, and is done without either muscular energy or mental activity. He has done that same job for eight years and has refused offers of promotion. But he has saved \$40,000, owns his own home, and drives his own car. It is said that a thorough study has not revealed in that factory a single case of a man's mind being twisted or deadened by such repetitive work.

As to taking skill out of the industry, it is pointed out that, rather, it makes the



Photograph by Clifton Adams

#### BOOKS COME BY MOTOR TO GLADDEN THE LIVES OF THE COUNTRY CHILDREN

Many counties are introducing a motorized circulating library service for the rural districts.

unskilled laborer partner of the skilled engineer, enabling him, with a mechanism designed by the engineer, to do a job commanding twice the pay he could get without the machine.

#### LITTLE ECONOMIES THAT MAKE BIG PROFITS

The old-time tool-sharpener was an expert judge of heat temperatures, but his was a hit-or-miss operation. Now the man who heat-treats steel in an automobile factory has nothing to do with the heat. He never sees the pyrometer that tells when the necessary degree of





Photograph by Clifton Adams

EVEN THE MOUNTAIN COTTAGE FEELS THE TOUCH OF THE AUTOMOBILE

Washington County, Maryland, sends its free library service up into the foothills of the mountains to carry the benediction of books to the poor.

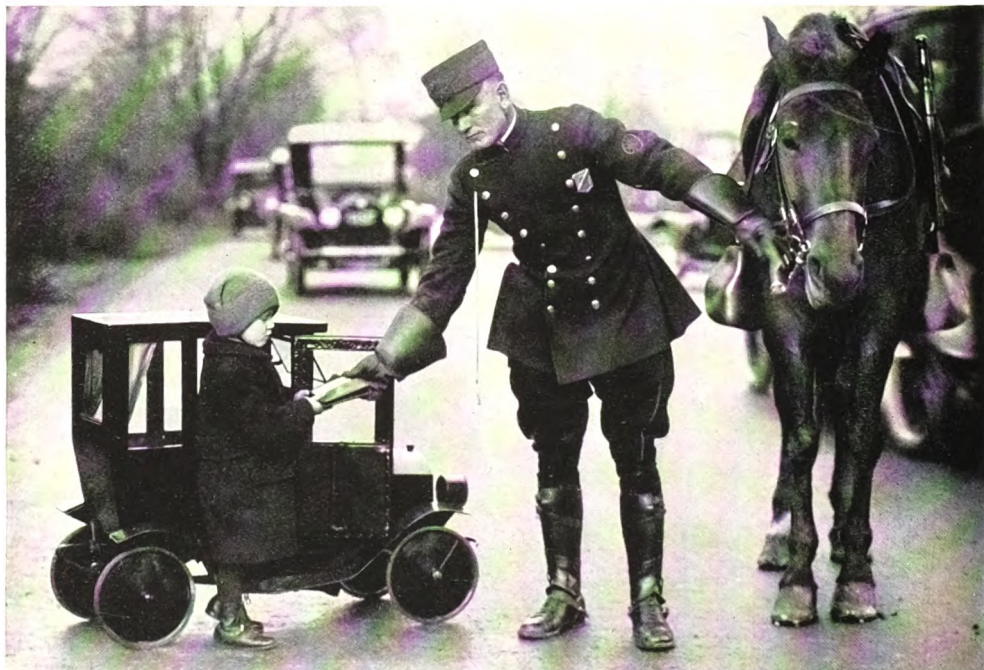




THE MORNING TOILET ON TOUR

Camping outfits of many kinds and degrees of comfort are on the market to-day, and the demand for them is showing a remarkable increase with each succeeding tourist season.





MINIATURE "TWIN-LEG" SEDAN

A Boston mechanic built his son a toy automobile with everything orthodox save an engine. The young motorist insisted on finding a "cop" who would "arrest" him.



Photographs by International Newsreel

SEEING THE COUNTRY GYPSY FASHION

This bungalow car, fitted with the comforts of a modern apartment, including electric lights and plumbing and a convertible living and bed room, has brought happiness to a motor-minded family. Even the driver's seat can be converted into an upper and lower berth.





A GROUP OF CHILDREN FROM SIX STATES FORMING A HAPPY CIRCLE IN OVERLAND PARK CAMP GROUNDS, DENVER, COLORADO

Hundreds of cities and towns have provided camps for tourists, most of them equipped with electric lights, kitchens and sanitary conveniences, and provided with police protection. One Missouri town of 7,000 inhabitants recently made a count. Its citizens welcomed 23,520 cars, carrying 100,000 passengers, during the touring season. More than 3,000 cars, carrying 12,000 passengers, stopped at the town's free camping site.

temperature is reached. Colored electric lights are automatically switched on to tell him when to remove the steel.

Even the "flivver" type of car has about 5,000 parts, counting screws, nuts, and all, and assembly on a quantity production basis must be nicely worked out in every plant. A shortage in a single type lock washer or bolt would tie up the whole line; so the flow of parts must always be constant and dependable.

When it is remembered that the saving of a single cent on each car's production cost means nearly \$20,000 a year in the

case of the Ford, and \$5,000 in the case of the Chevrolet, it can be seen what large prizes small economies win in big factories.

In one plant, the sweepings alone represent a saving of more than half a million dollars annually, and the elimination of a single style of bolt means another half million. Making transmissions in the factory, instead of buying them, saves nearly \$20,000,000 a year.

To see a big blast furnace tapped, to watch its white-hot stream of molten iron flow off into giant 75-ton ladles, from





Wide World Photograph

THE REMAINS OF A RAIDED STILL ABOARD A FAITHFUL "FLIVER"

There is a Ford driver born every thirteen seconds to keep pace with the output of the automobile plants at River Rouge and Highland Park.



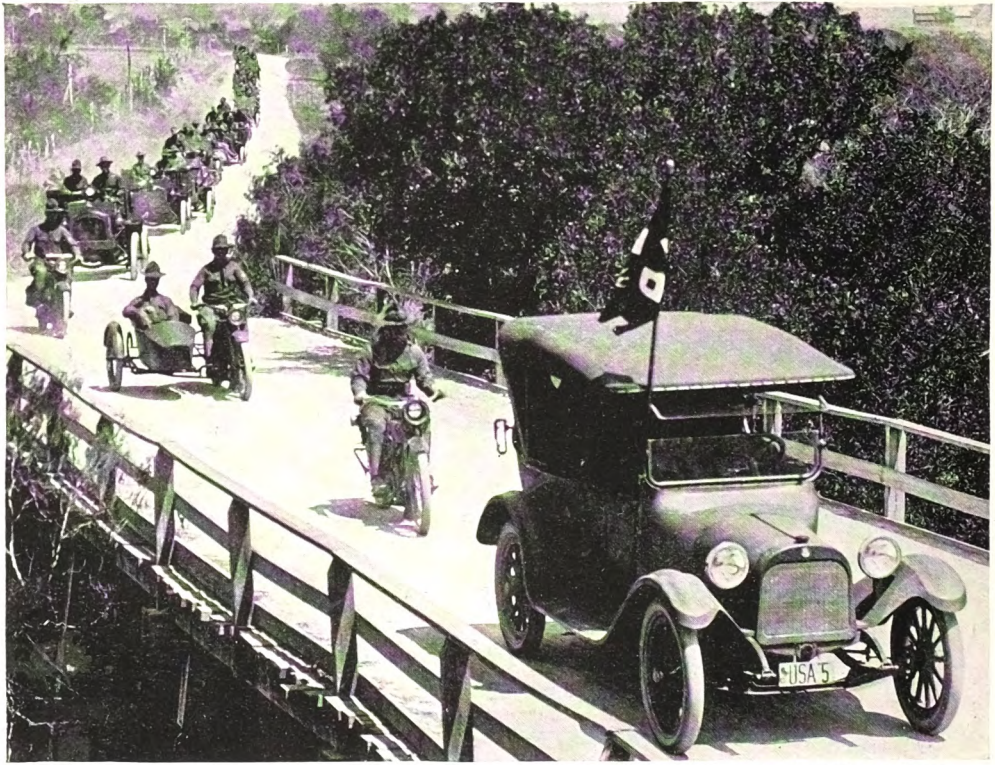


© Ewing Galloway

A MODERN MOTOR BUS AND A CAR OF THE TRACTION LINE IT SERVES

Sixty electric lines are now using motor busses to supplement their service. They serve admirably in new territory as feeders to established street-car and interurban traction lines.





Photograph from the U. S. Signal Corps

#### MOTORIZED TRANSPORT IN THE UNITED STATES ARMY

which it is then emptied into cupolas, to be, in turn, drawn off in small quantities and poured into waiting molds, is to behold an epic of industry—molten iron from the blast furnace's fierce flames poured into the mold itself, without the intervening pig-iron stage.

Going through the major plants of the industry is an experience one can never forget. Following the main processes in car fabrication, we pass from the foundry, where the fiery liquid is molded into parts, into the forge building, where they are heat-treated and shaped.

Here is a giant triphammer capable of delivering a four-ton blow, and yet so skillfully operated that it can be made to tap a watch without breaking the crystal, or to touch a finger ring so lightly as to leave only a slight grease mark thereon (see page 386); there, a tremendously powerful press that shapes a crankshaft with the seeming ease with which a child presses out a mud pie.

Elsewhere we see a battery of pots, using, in heat-treating various parts that

are to be subjected to hard wear and rough usage, enough molten cyanide every day to kill all the people in the Western Hemisphere (see page 376).

Leaving the forge department and passing on to the machine shop, one encounters a thousand mechanical marvels. There one sees immense multiple drill presses, some of them capable of boring more than fifty holes simultaneously in four directions, each perfectly true in its direction, in an engine block; piston-grinding machines that automatically grind four pistons at a single operation, facing the top and turning the outside diameter at the same time; screw machines that automatically feed themselves long steel rods, four or more at a time, and transform them into perfect screws—heads, threads, and slots.

A whole battery of machines in this department is busy milling the "cheeks" on the "throws" of crankshafts, each one doing what formerly required twelve different operations, on as many machines, each manned by an operator.





Photograph by Paul Thompson

## A MEMBER OF THE MOTOR CORPS IN THE WORLD WAR

Another battery of machines is cutting teeth on gear-wheel blanks. One man attends a number of them, and all they ask is that he give them a regular supply of blanks and liberal streams of oil over the cutting surface.

## FASHIONING FENDERS AND BRAKE DRUMS

Elsewhere an endless procession of engine blocks is coming down the line, each block being cut and trimmed into shape by powerful cutters to which iron seems little harder than cheese. One type of these milling machines takes a series of blocks and rotates them past the cutting tool instead of moving them one at a time back and forth on a platform. One of these machines takes the place of twelve of earlier design, occupies only a fifth as much floor space, and reduces the human factor to a minimum.

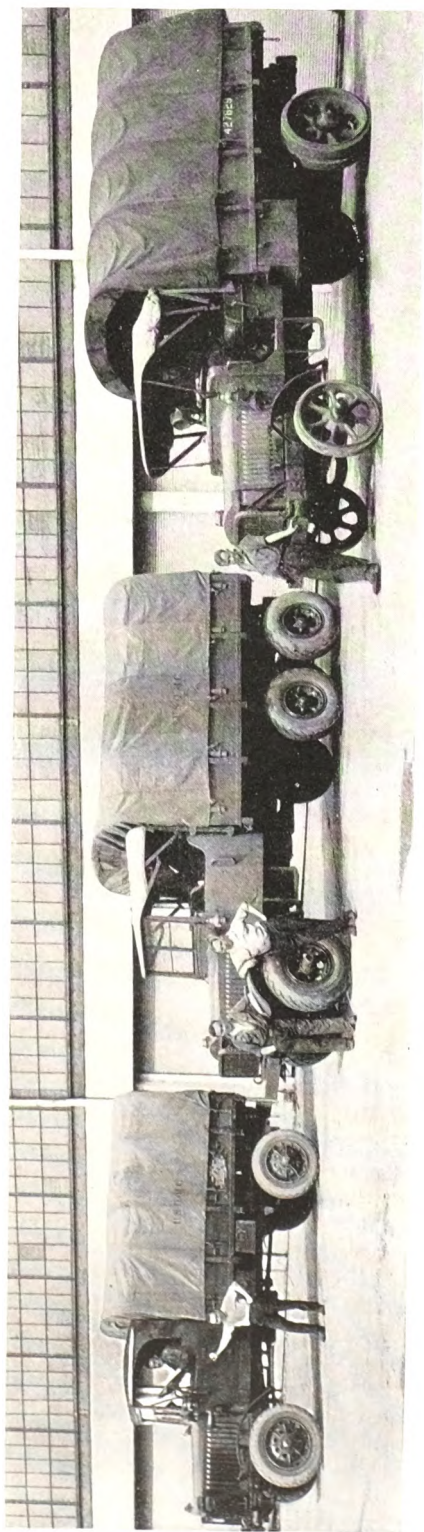
From the machine shop one passes to the stamp-press shop, where other wonders await him—machines that cut blanks out of sheet steel as easily as the housewife cuts cookies out of dough, and much

faster; others that transform steel disks into brake drums at one operation; still others that stamp fenders out of sheet steel with a single movement.

Here are spot-welders that baste the two parts of an axle housing together just as a seamstress bastes a sleeve before sewing it. The operator holds the two pieces of steel together, touches a switch, melts a spot on the two edges, and causes the steel to run together. This binds the two parts together for the man who is to finish the job.

One watches cylinder-grinding, where  $1/10,000$  of an inch is the limit of tolerance in departure from exact size; follows piston-ring inspection with measuring instruments, in which rays of light are made to reveal fine variances that escape detection by ordinary means; studies dynamometer tests that reveal the exact horsepower developed at all speeds; examines the machine that calculates the area of an irregular piece of leather a thousand times as fast as it could be determined by arithmetic! (see page 362).





Photograph by Clifton Adams

## ARMY TRUCKS AT CAMP HOLABIRD, BALTIMORE, MARYLAND

The truck on the right is the regulation army truck widely used by our Expeditionary Forces in France. In the middle is the new six-wheel truck recently devised (see page 404). By the use of oversized tires, the ratio of weight per square inch on the road surface is reduced from 7 to  $2\frac{1}{2}$ . The truck at the left is also a new design, built at Camp Holabird and having a four-wheel drive. This truck will go almost anywhere that a caterpillar tractor can operate, and some places it cannot, and at the same time it has a high road efficiency.

Likewise, one is inclined to linger along the assembly lines, watching engines and transmissions and rear axles being built up and coming down to the main line where they meet the chassis and are made a part of it. The paint shop, where the enamel is sprayed on and the steel body is sent on moving platforms through the drying kilns; the upholstery and trimming department—a score of fascinating activities beseech attention, but their “say” must be with pictures (see pages 353-355, 358-360, 362, 363, 366-370, 376, 377, 386, and 387).

The employment of machinery in the making of automobiles and the quantity of product turned out are among the marvels of this mechanical age. If old-time hand methods were used, it is estimated that a single plant in the industry would require two million workmen where now less than 100,000 are employed, and even a “flivver” would cost almost as much as the most expensive car to-day.

## A TRIBUTE TO GENIUS

The American tribute to the automotive engineer's genius has made his industry the third largest in the United States and has enabled it to bow petroleum into second place. The automotive vehicle manufacturer has become the largest producer of finished goods in the world.

Looking down the line of motor cars put out, from the Packards, Pierce Arrows, Lafayettes, Locomobiles, Lincolns, Cadillacs, and Marmons, with their superlative standards of construction; to the Fords, Stars, Grays, and Chevrollets, designed to meet the essential requirements of those of moderate means, we find that everywhere there is an amazing amount of mileage in them per dollar invested, when given proper care and operated at speeds consistent with their construction.

H. C. S.'s, Stutzes, Wintons,



Hudsons, Studebakers, Chandlers, Nashes, Franklins, Buicks, Reos, Hupmobiles, Maxwells, Chalmers, Dodges, Durants, Overlands, and many others, offer a range of choice in price and type to meet every taste and every requirement, but any one of them represents a good car within the price range to which it belongs.

It is true that the manufacturers, in the main, make big total profits, but these grow small when brought down to a per-car basis. Most of these profits arise, moreover, by economies. The Studebaker South Bend plant, for instance, spends \$3,000,000 for a new foundry; this will pay for itself in the economies of a comparatively short time.

#### THE HIGH COST OF DISTRIBUTION

The high cost of distribution is one of the striking factors of the automotive industry. The economist who wrote that it costs as much to sell a car as to make it probably went a little beyond the mark, but at that, the margin between the wholesale and retail prices is vastly larger than that between cost of production and the wholesale price.

Economists generally agree that more than one-half the price the consumer pays for the commodities he uses represents the costs and profits of handling them between the producer and the consumer. The late President Harding called this one of the greatest problems of civilization, if indeed not the greatest.

The motor truck has been asked to help solve this problem, and it seems to be making a substantial contribution thereto. A big New York firm found that the ton-mile delivery cost fell from 48 cents with horses to 20 cents with motor trucks.

In Milwaukee, Wisconsin, the milk companies decided to motorize their quantity milk delivery, and the result was a saving of two cents a quart on their product.

A Detroit department store has instituted a new motorized delivery service and now delivers within a radius of 75 miles, giving a vast rural and small-town population a service never before thought possible.

A study of truck statistics shows that eighty-three out of every hundred built

last year were of one-ton or less capacity. A quarter of a million trucks were built that year and there are now about a million in commission in the United States.

In most cases where the motor truck has gone into delivery service in competition with the horse, it has been able to cut down the delivery cost in almost as large a proportion as it accelerates the time of delivery. We all love the horse, but economy is the prime consideration of the business world.

The truck also has a vast field before it in handling the short-haul freight that the railroads now handle. Any rail shipment that is for less than forty miles is apt to be carried at a loss. The railroads, it is said, want to give this business to the motor truck. Likewise, they would gladly remove their freight depots from the centers of cities, since the interest on such investments wipes out the profits of package freight handling. They would like to have their freight stations outside of congested districts and let the motor trucks take care of the city delivery.

#### CINCINNATI RESULTS SHOW WHAT TRUCKS CAN DO

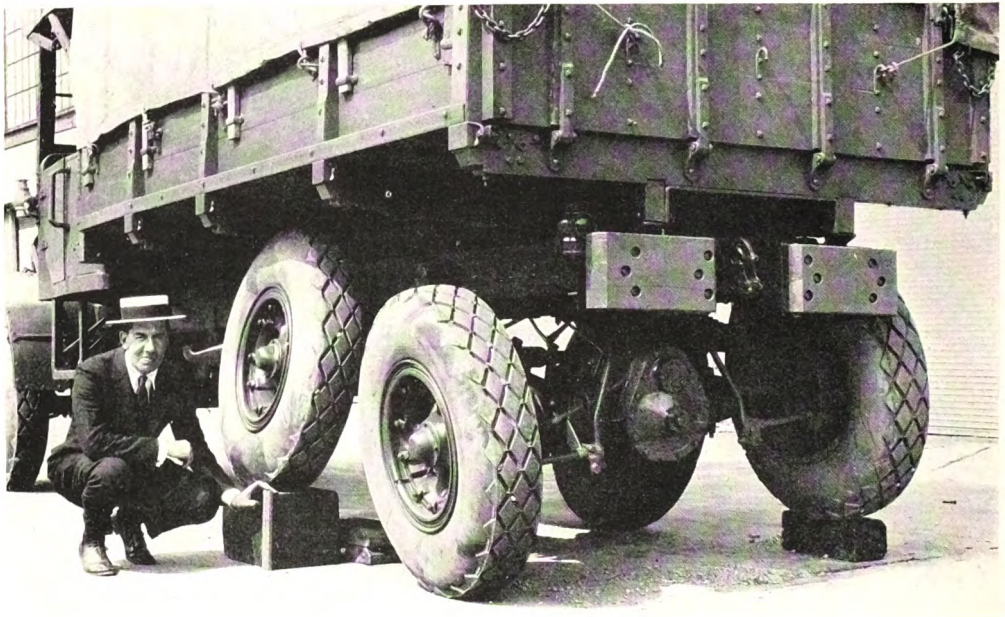
In Cincinnati motorized freight terminals have been established. In a single year they released 66,000 cars for main-line movement on the railroads, eliminated 300,000 switching cuts, advanced freight movement over 52 hours, and cut the labor cost in half through the elimination of rehandling.

One of the abuses of the motor truck is to put it on long hauls that parallel railway lines. Statistics definitely show that long-haul truck lines sooner or later go out of business, only to be succeeded by others which, in their turn, find the competition ruinous. But in the meantime, they have made uneconomic inroads into the earnings of the railroads and cut down the service rail lines can render to a fraction of its former efficiency.

One of the uneconomic situations which has developed in the past generation is strikingly illustrated between Dayton, Ohio, and Indianapolis, Indiana.

There used to be a good rail service between these two cities that yielded a reasonable profit to the railroads. Then there came into the field a new carrier—





Photograph by Clifton Adams

A NEW SIX-WHEEL TRUCK DESIGNED BY THE QUARTERMASTER'S DEPARTMENT, U. S. A.,  
AT CAMP HOLABIRD

This picture shows the flexibility of the truck construction of the new six-wheel type the army is developing. The one-foot rule shows the height of the block on which the one wheel rests. The block on the opposite side is six inches high. The four-wheel rear construction shown here can be built for the Government at practically the same expense as the orthodox two-wheel single-axle construction.

an interurban traction line. It so ate into the business of the railroads that they were forced to curtail their service.

But still later the fine motor highway between Dayton and Indianapolis was opened up, and it, in turn, made heavy inroads upon the traction line.

Some day there will be a coordination of our transportation facilities that will adjust such conditions, making each an asset rather than a liability to the other. When railroad, traction and motor lines are correlated properly, each will add to the strength of the others and the public will be vastly the gainer.

The truck is fast eliminating the horse from the cities of the country. Between 1910 and 1920 the number of horses in New York decreased from 128,000 to 56,000; in Chicago, from 68,000 to 30,000; in Philadelphia, from 50,000 to 19,000; in Baltimore from 15,000 to 7,000; in Cleveland, from 16,000 to 4,000.

The Quartermaster's Department of

the Army, at Camp Holabird, under the direction of Arthur W. Herrington, is developing two types of trucks that promise to revolutionize truck construction for heavy duty. One of these types has a four-wheel drive, with oversize pneumatic-tire equipment. This truck will go almost anywhere that caterpillar tractors can go, and some places that they cannot, in cross-country work and on wet clay roads; and on top of that, it will do anything that a regulation truck will do on good roads. As efficient as a caterpillar in bad going and as speedy as a regular truck on a good road surface, it can be built at a reasonable cost.

The other is a six-wheel truck capable of handling a  $7\frac{1}{2}$ -ton load, with even less pressure per square inch of tire-road contact than the ordinary 3-ton solid-tire truck. The four rear wheels are assembled after the fashion of the ordinary railway-car truck, and are driven by a double differential from the propeller shaft.





Photograph by Paul Thompson

A FLEET OF TRUCKS ON THE COURTHOUSE PLAZA IN BALTIMORE EN ROUTE FROM  
DETROIT TO FRANCE

Both of these trucks are built up out of standard parts, and not only will they develop new fields for automotive transportation in time of peace, but they will also constitute the types of heavy-duty vehicles the Army will want in the unhappy event America ever has to unsheathe its sword again.

THE TRACTOR'S PART IN THE HORSELESS  
AGE

The farm naturally is the last stronghold of the horse. The natural inertia of the farmer has something to do with this. But more than that, the tractor that will serve him as well in its field as the motor car does in its sphere has not until now shown signs of appearing.

First of all, it must be a tractor that can utilize existing farm implements. An investment of \$3,500,000,000 in horse-drawn equipment is too great to send to the scrap heap.

It must, therefore, be capable of operation by reins, just as if it were a team of horses. This gives freedom to the operator to attend the machinery being pulled, as well as to the tractor itself.

In the second place, it must be so designed that it can be used in cultivating row crops like corn; it must be able to straddle one or two rows and turn in a small radius at the end.

In the third place, it must be able to render efficient belt-power service, so that the farmer can hitch it to a wood saw, a threshing machine, and whatnot.

The fourth requirement is that it shall take the place of the horses on the road as well as in the field, so that it may be fully able to substitute the horse.

Happily, all these specifications have been, or are being, filled except the last. To make a wheel that is readily converted from one with a cleat-studded rim for field duty into one with a smooth rim for road work is a task that is engaging the attention of the best engineers. One manufacturer says he will pay \$25,000 for the wheel that completely meets this need.

A NEW ECONOMIC TRANSFORMATION

With Canada announcing a half-billion-bushels wheat crop, with Siberia on the eve of bonanza cereal farming, with





© Paul Thompson

**FIGHTING A CHEMICAL WAREHOUSE FIRE IN NEW YORK WITH MOTORIZED APPARATUS**

The fine spectacle of dashing fire horses is rapidly disappearing. Many of the major cities have completely motorized their fire-fighting equipment. Not long ago the last of Chicago's horse-drawn fire apparatus was discarded, the occasion being made a ceremonial one. A box a short distance from the station was pulled to start the four horses on their last run; after they had left, the new motor equipment was driven in. The efficiency of fire apparatus involves speed and convenience in reaching a fire. Breakage due to rapid runs and the additional hazards of bad pavements and crowded streets result in the necessity for adequate repair departments. New York maintains well-equipped shops where not only worn and damaged apparatus is repaired, but new apparatus is given careful and practical tests before purchase.





Photograph by Paul Thompson

#### PUTTING A NEW MOTORIZED WATER-TOWER INTO ACTION IN NEW YORK

The most precious moments in combating a fire are those before the flames have had time to spread. The reduction of time in getting to the scene after the alarm reaches the engine-house, by the substitution of motorized for horse-drawn apparatus, has resulted in checking many a potential conflagration.

Argentina and Australia developing in rapid strides, the American farmer must become a more efficient producer to meet their competition, which has much more to do with the present low prices of farm commodities than most people realize.

In those countries cheap lands produce large holdings and vast fields, where production costs per bushel can be driven down by highly organized power farming.

#### POWER FARMING AND PRODUCTION

Experience throughout the tractor farming belt shows that if the farmer values his labor at current rates, it costs less to sow and reap an acre of wheat with tractor-drawn equipment than with horse-drawn. Experiment-station records in our Western grain belt present

striking illustrations of this. The reduction in labor costs goes down much faster than equipment and maintenance costs go up.

But that is only the beginning of the story. Power farming and horse cultivation of identical tracts in Kansas resulted in eleven years in the production of eight bushels of wheat on the power-farmed tract for every five on the horse-tilled land.

The secret of this success of the tractor over the horse was that, with the former, the land could be plowed seven inches deep in July, while with the latter, owing to the heat in midsummer, it had to be plowed five inches deep in September.

As the July-plowed soil contains one and a half times as much moisture as the





A REMINDER OF THE TIME WHEN GRAIN WAS SOWN BROADCAST

Handpower gave way before horsepower a generation ago; and now, in its turn, horsepower is facing a formidable rival in tractor power (see illustration, page 414).





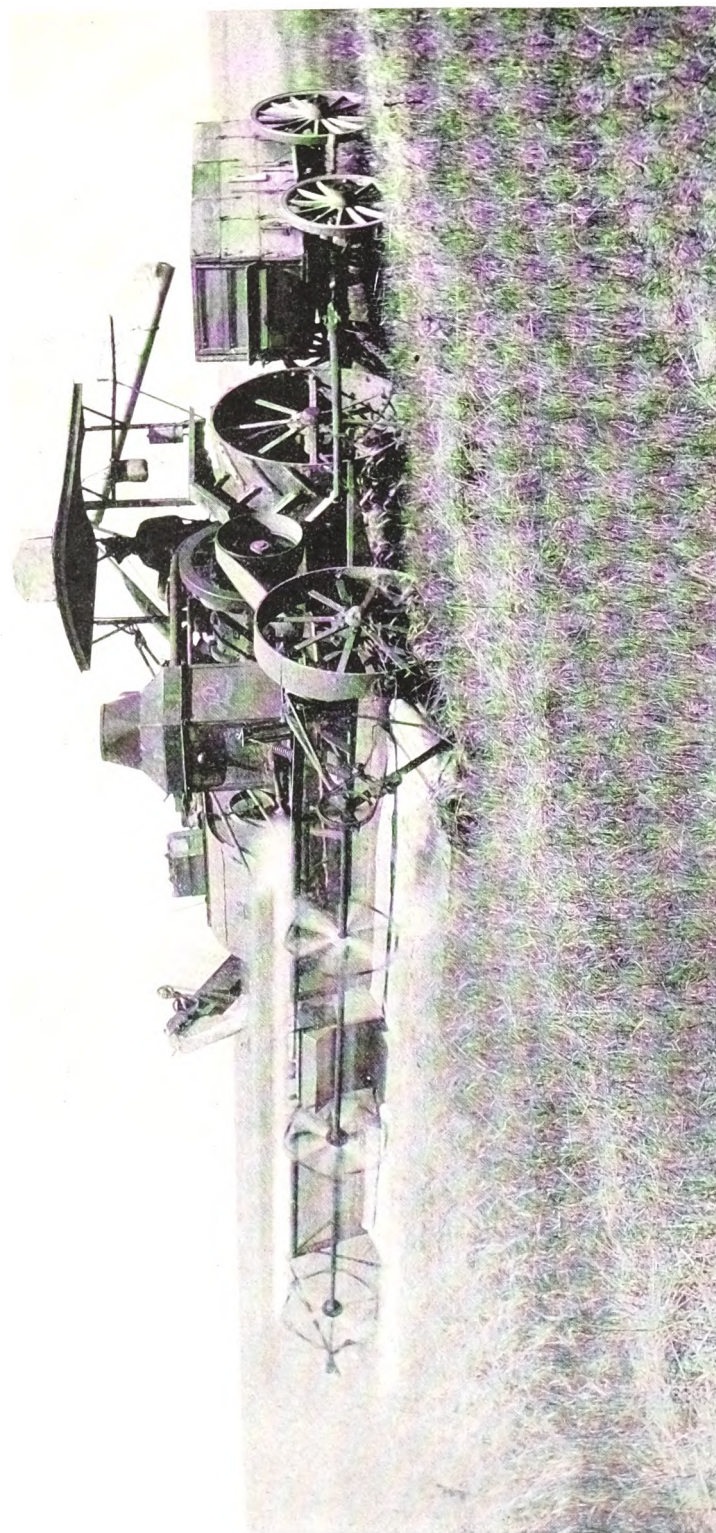
DRAGGING OUT STUMPS IS ONE OF THE MANY JOBS ASSIGNED THE TRACTOR WHEN THE "BUSY SEASON" ON THE FARM IS PAST



CLEARING NEW GROUND WITH A TRACTOR

Five acres per day can be cleared with a thirty-horsepower tractor and a twenty-four-inch plow. The reader born on a farm will doubtless remember the time when the brush this machine plows under had to be grubbed out, piled and burned, and the ground "ripped" up with a "bull-tongue" shovel plow.

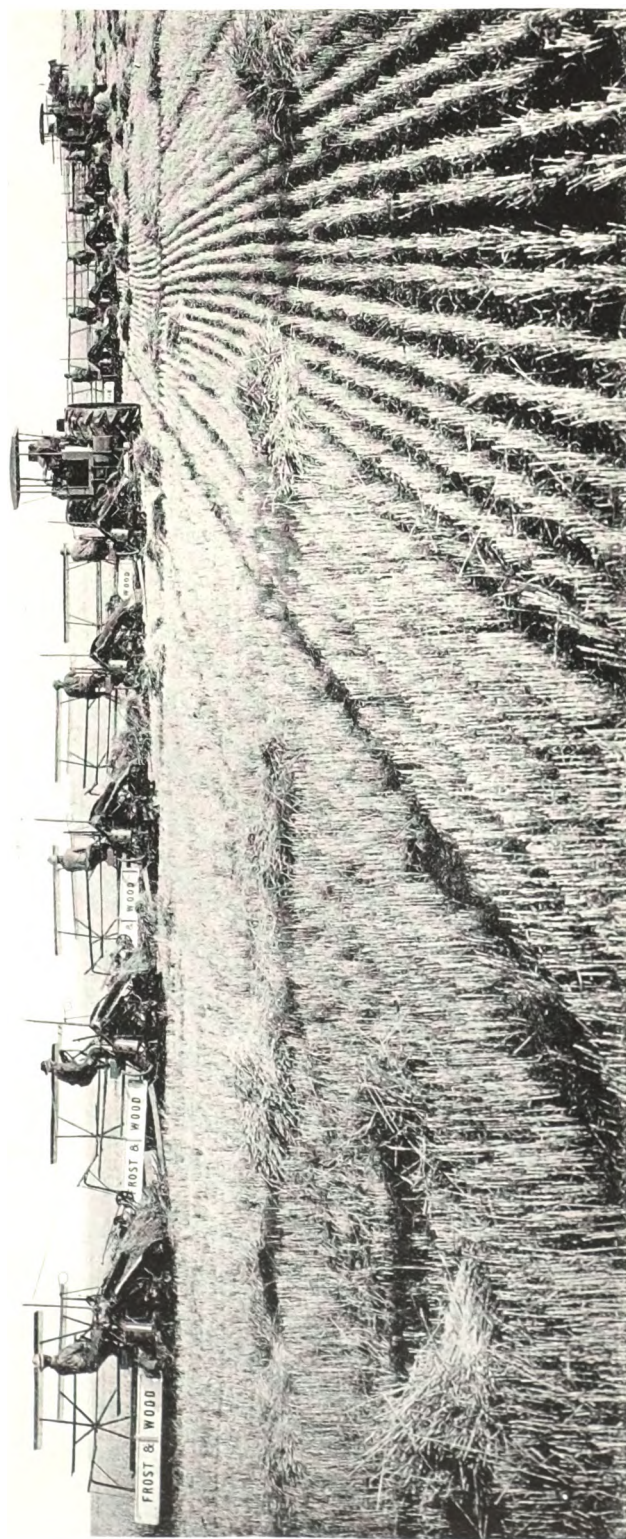




A "COMBINE" AT WORK ON A CANADIAN FARM

This machine cuts, threshes, and delivers to the wagon alongside more than 100 acres of wheat a day. Many elderly people can remember the grain-cradle and hand-flail era, when it would have required the labor of some three hundred men to do the same work in the same length of time, to say nothing of the twenty-eight horses required to haul in the crop. Even the binder and the threshing-machine would call for about sixty men and forty horses for cutting, hauling in, and threshing a hundred acres of wheat in a day.





BONANZA FARMING IN CANADA

This picture of operations in a seven-thousand-acre Canadian wheat-field shows the character of the competition the American farmer must meet in the future. One tractor and six men do the work of twenty-eight horses and fourteen men, with horse-drawn binders. The high cost of labor will do more than any other agency to bring about lower production costs on the farm by necessitating an increased substitution of machines for hands.

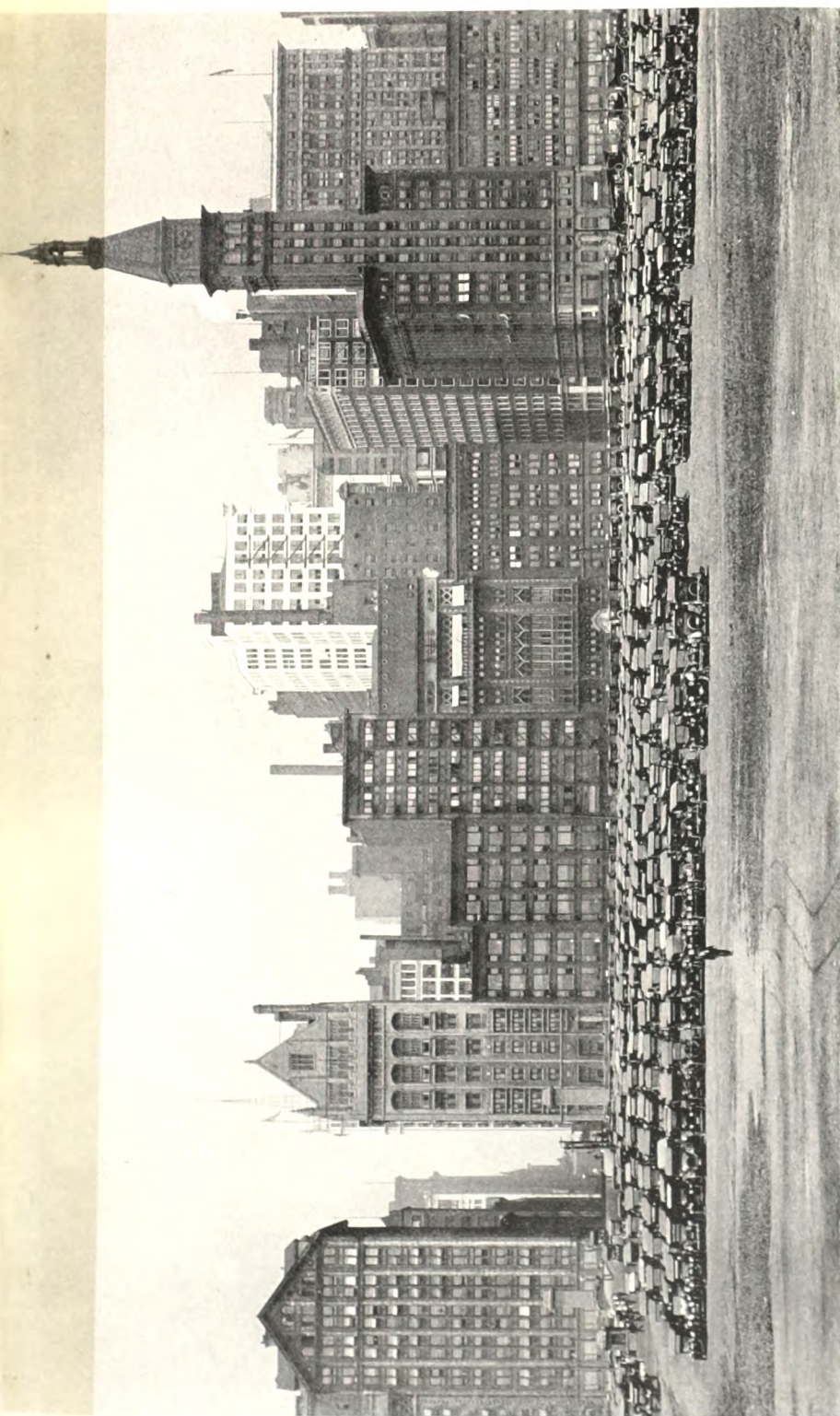




DISK-PLOWING THE RICH PRAIRIE SOIL OF THE MIDDLE WEST

The thousands of quarter-section farmers do not make interest on their investment, much less a profit, with dollar wheat. The large tract, with power-farming methods, can show a profit, even at such a price.



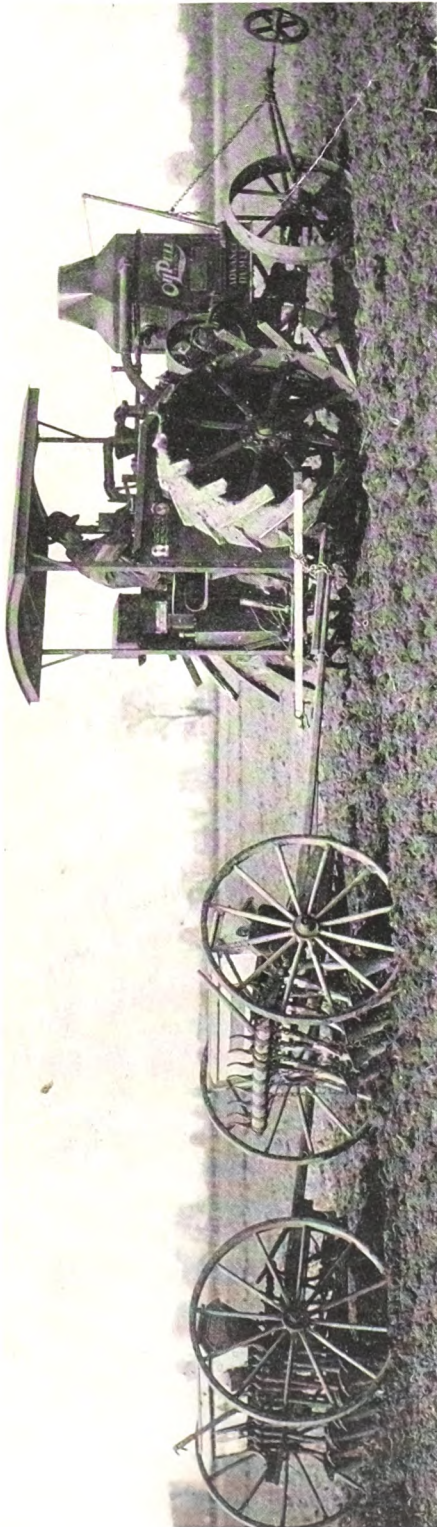


Photograph by Kaufmann & Fabry Co.

PUBLIC PARKING SERVICE IN THE RECLAIMED GROUND ALONG MICHIGAN AVENUE, CHICAGO

The vast demand for parking space in Chicago is met by the establishment of a public outdoor garage, where cars may be checked for a nominal fee. The motorist gets a check, and the car is not released except upon its presentation.





TRACTOR-SEEDING ON AN UP-TO-DATE FARM  
Contrast this picture with the one on page 408 and note the progress a single generation has wrought.

September-turned, and as deep plowing turns up more plant food than shallow, it is easy to account for the difference in yield.

These examples of lowered per-acre costs for cultivation through the elimination of high-priced labor, and increased per-acre yield through better methods of cultivation might be multiplied indefinitely.

#### THE DAWN OF A NEW ERA

We stand on the threshold of another transformation in farm life, as significant and as far-reaching as that which took place when the farmer laid away his scythe, grain cradle, and flail for the mower, the binder, and the threshing machine.

By substituting machines for hired hands, the farmer will lighten his heaviest load—high labor costs.

When the versatile utility tractors that are now ready to come on the market make their bows, the farmer will settle the labor question as he settled it with his binder and mower.

He will discover that he can so decrease his labor cost and increase his acre yield as practically to make two dollars grow where one grew before.

The substitution of power for horses will mean millions of people released from agriculture for industry, as was the case when the farmer substituted horses for men.

With more urban mouths to feed and backs to clothe, and fewer rural ones to provide for, a new day will dawn when the efficiency of the factory will come to the farm, and then the American farmer can do what the American automobile maker has done—meet the competition of the world and still make money.

And when the noontide of that day is reached, the great triumvirate—the passenger car, the freight truck, and the farm tractor—are destined to write a record of service to America that will stamp the automobile engineer as one of the foremost contributors to human welfare in all the history of mankind.





C100762203

**RETURN  
TO →**
**Institute of Transportation Studies Library  
412 McLaughlin Hall**

ALL BOOKS MAY BE RECALLED.  
Overdues are subject to replacement charges.

Renewals may be made by phone:  
(415) 642-3604

**DUE AS STAMPED BELOW**

Rec'd 11/26		
MAY 23 '89		
MAY 24 1990	REC'D	
APR 24 1990		

©1

UNIVERSITY OF CALIFORNIA, BERKELEY  
FORM NO. INST. TRANSP 50M, 11/79      BERKELEY, CA 94720



